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Schoolhouse Heating and Ventilating in Indiana

Analysis of Existing Conditions, Covering Warm Air Furnace, Steam and Hot Water Systems.

A remarkable presentation of present-day conditions in the design and application of mechanical heating and ventilating systems, with special reference to Indiana, has been prepared by Professor C. B. Veal, professor of mechanical engineering at Purdue University, at the instance of the State Department of Inspection and Supervision of Public Offices. The report is confined to schoolhouse heating and ventilation, but the findings, in many respects, apply to all classes of heating work.

In the first place the report states that a diversity of opinion has existed for several years with respect to the relative merits of the various systems of heating and the ventilation of public school buildings and their compliance with the sanitary schoolhouse law of Indiana. The controversy between manufacturers of heating and ventilating systems and between contractors is renewed practically every time bids are received by township trustees and school boards and has frequently resulted in the elimination of meritorious systems, on the theory that such systems do not comply with the sanitary schoolhouse law. This practice, the report states, restricts competition, fosters monopoly and, in many instances, results in contracts being awarded upon bids that are not the lowest submitted. It encourages collusion, conspiracy and extortion. Arguments made by manufacturers and contractors often confuse officials who are not experienced in heating and ventilating, and contracts are frequently secured for inferior heating systems at exorbitant prices through gross misrepresentation. It would be difficult to estimate the loss sustained by the taxpayers of the state through this corrupt practice.

The object of the department in making an investigation of this important matter was to find the system of heating and ventilating that will meet the requirements of the law, best conserve the public funds and encourage legitimate competition. It was the department's opinion that this question could be solved only by a searching investigation by expert heating and ventilating engineers who were in no way connected with the manufacture of heating and ventilating apparatus, or interested, directly or indirectly, in the heating business.

Professor Veal's investigation and the tests of existing systems were on the basis of the provisions of the sanitary school house law of Indiana, namely: heating, ventilating, humidity, initial cost, durability, up-keep, safety, operating cost and cleanliness. During the in-

vestigation, Professor Veal consulted those in charge of the engineering department in some of the largest universities of the United States and gave due consideration to their suggestions. He spent many months in making various tests and in the compilation of his report, which is regarded as the most complete of its kind published in the United States. Its practical use by township, school and other public officials who have charge of the construction of public buildings, including the installation of heating, ventilating and plumbing equipment, will, it is expected, effect a large saving to the taxpayers of Indiana, estimated by expert engineers at more than $100,000 annually.

The report states, in part:

No attempt will be made to formulate definite specifications and rules for procedure in schoolhouse heating and ventilating. Attention will rather be directed to an analysis of the existing situation leading to certain recommendations which, if approved, may form the basis for regulating measures.

Any study of the present question logically divides itself into three considerations, the *available methods,* the *law* and the *demand.* Before a selection of heating methods can be made there must be a clear understanding of the principles of operation and relative adaptability of existing systems to schoolhouse heating. Under the *second* consideration, interpretation must be placed upon the provisions of the existing law, and classification made of available systems in accordance with their qualifications to compete under the law, *i. e.,* "What does the law specify?" and "To what extent can the various systems qualify under the law?"

Under the third head two parallel questions should be considered: "What is demanded in the heating and ventilation of schoolhouses?" and "Which systems will best satisfy these demands?"

After describing the existing systems the report takes up the qualifications of the different systems.

HOT-AIR FURNACE SYSTEMS.

Following are the opinions expressed of warm air furnace systems, and steam and hot water heating systems:

The conventional hot air furnace is little more than a specially designed stove surrounded by a casing and usually installed in the basement of the building to be heated.

Although it may be regarded as the most common method of small residence heating today, as compared with other systems providing ventilation, its only advantage for schoolhouse heating lies in its low first cost. Its disadvantages are those common to the system, in residences or wherever installed, the principle of these lying in the fact that by this means it is very difficult to heat any portion of a building while that particular portion is directly exposed to a strong wind. Another serious objection to the hot-air furnace system is that the ducts are liable to become unsanitary through the collection of dust, and any cracks or leaks in the furnace permit the absorption or entrainment of noxious gases and soot by the incoming air, thus impairing, rather than improving ventilation.

Such a system cannot be recommended for schoolhouse heating except for buildings with not more than four rooms, where economy in first cost is absolutely essential, and then only when the utmost precaution is taken in the design and construction so as to comply with the intent of the law and the requirements of uniform heat and good ventilation.

FORCED CIRCULATION—HOT AIR FURNACE SYSTEMS.

With increased initial, operating and maintenance costs hot air systems, with forced circulation, will be subject to the same disadvantages as the gravity hot air furnace, except for positive circulation of the air to all parts of the building with less regard for the disturbing influence of outside winds. Although

not an inherent fault of the system, the type of fan employed in its installation has all too frequently been inefficient and wholly unsuited to the economical propulsion of air under the required conditions of pressure, thus further increasing the cost of operation.

The impact under pressure of the cold air from out of doors against the frequently almost red hot fire-surfaces of the furnace is quite likely to develop cracks and leaks through strains produced by sudden cooling or unequal expansion of the metal, rendering this type of equipment more objectionable than a gravity plant by way of supplying coal gas and the products of combustion along with the supposedly "fresh" air. Evidently the fire hazard of such plants is very great and it is a matter of record that serious fires in public schools have so frequently been traced directly to furnace systems as to render the selection of such a system unwise from the standpoint of common safety. Furthermore, the temperature of the furnace is sometimes very high, and reducing the supply of air at any time tends to increase the furnace temperature, since the air supplies a cooling effect. Such a reduction in the supply of outside air will naturally increase the outgoing temperature of that which is supplied, thus resulting in excessively high temperatures of air entering class rooms. Temperatures as high as 275° F. have been observed by one of the best authorities. Such a temperature is dangerous to the structure of the building and, furthermore, very materially increases the fire hazard. It is unnecessary to call attention to the probable withering dryness of this air, or its harmful, if not positively painful, effect upon pupils subjected to its draught. With even normal temperatures of operation for a fan-blast system it will be found extremely difficult to consistently comply with any proper requirement in humidity, unless elaborate and expensive equipment be installed.

It may thus be seen that hand regulation of temperature and humidity may prove exceedingly troublesome; any attempt to secure automatic temperature and humidity control is sure to prove an expense incommensurate with type of plant, and probably equally unsuccessful, unless made the subject of continuous care by a highly paid expert.

The erection of such a plant is particularly inadvisable where electric current is not available for driving the fan. Inasmuch as no steam is generated in the plant an internal combustion engine,—of a size and type expensive, noisy and uncertain in operation,—represents the only available motive power in such cases. The necessity of having gasoline fuel stored in or about the building constitutes, within itself, an added danger.

Although it is possible to find individual instances where the cost of operation of a fan furnace system has been less than that of a similar steam system, the consensus of opinion, from such records as are available, is that steam or "fan-coil" systems are less expensive to run, while without exception a direct-indirect steam system can be operated more cheaply. Light weight and poor construction of parts of the usual fan-furnace system, together with the development of cracks through great unevenness of temperature, lead to numerous and expensive repairs, often bringing the cost of maintenance above that of any normal allowance for depreciation. Whatever may be the advantage of the fan-furnace system it has been the almost universal experience that where such equipment has been installed it has been removed and replaced by some sort of steam system within a period of ten years, because of unsatisfactory service.

If this system is to be installed it should be with the best modern type of plate, or preferably multi-vane fan; it should have a furnace of ample and properly proportioned grate and heating surface for this particular work; and no contract should be let for such a system in any building without the approval

of a competent and disinterested heating and ventilating engineer, and the health authorities.

HOT WATER SYSTEMS.

While the low temperature of radiators, leading to greater transfer of heat through convection than through radiation, and consequently a more natural quality of heat, appears to commend hot water heating for direct radiation in school rooms; on the other hand, its high first cost, even with gravity circulation, lack of positiveness in circulation without pumps, large radiating surface, particularly with indirect arrangement, slowness in "heating up" and liability to breakage in radiators through freezing make hot water unsuitable as a heating medium for schoolhouses, under most circumstances.

Without provision for ventilation in heating, it is quite possible in mild weather to run a hot water system with a very low fire, thus resulting in economy of operation, and securing a reduction in the coal bill which tends to offset the extra first cost of the installation; but during operation at full capacity the cost of fuel probably will be no less than for steam. This latter consideration will apply particularly with an indirect or direct-indirect system and there is little doubt but that the same money, if spent in installing a modern vapor-vacuum steam equipment, would result in just as low total cost per season.

STEAM SYSTEMS.

Heating by steam is made dependable and uniform in operation through positive circulation, without mechanical devices to force it, and in this respect is unquestionably superior to either hot air or hot water. When properly fitted and piped every radiator should be kept hot without trouble. The radiators and piping are smaller than for hot water and there is no danger of freezing even with indirect or direct-indirect radiators.

For heating small and medium sized buildings there have recently come into extensive use various so-called *atmospheric* and *vapor* systems. These are all of a patented character—and as such need not be minutely described here—designed to make use of the principle that water will vaporize, or turn into steam, at a lower temperature if under a partial vacuum. In this respect the vapor systems differ from the vacuum systems employed in large public and office buildings only in the method of producing, and the amount of vacuum carried. As it would not be economical to install an elaborate, motor driven apparatus in a rural or small school building several sufficient, positive and less expensive methods of producing a partial vacuum are offered by various companies. As in the case of *vapor* and *vacuum* systems the distinction between *atmospheric* and *vapor* systems is more one of degree than of kind.

In a flexible type of vapor system the degree of vacuum can be increased in mild weather, thus permitting practically as low fire as with a hot water system. By varying the amount of vacuum the temperature of the vapor or steam in the radiator can be graduated as with hot water, but with this decided advantage: during cold weather the steam can be put under pressure, operating as a plain pressure system, thus requiring no larger pipes and radiators than a normal steam installation. Moreover, the expansion tank of the hot water system is eliminated; air valves are replaced by vapor or vacuum traps at the radiator outlets; and a return pipe to the vacuum-producing apparatus insures good circulation, and makes the process of "heating up" even more rapid than with low pressure steam. At the same time it avoids the attention, leaks and unpleasant odors associated with most air valves. In some of these systems the radiators are equipped with special inlet valves designed to permit easy hand modulation or control of the amount of steam admitted to the radiator, according to de-

mand, thus effecting economy in the use of steam and reducing the pressure in the return pipes. There is no danger of injury where a radiator is exposed to freezing, and, in general, it may be said that, to a remarkable degree, these systems secure the advantages of both hot water and low pressure steam without the disadvantages of either.

Such systems do, however, have disadvantages peculiar to themselves. Primarily, objection to their use is based on liability of trouble arising from complications introduced in connection with the vacuum producing apparatus. Although more economical in design and equally efficient in operation, the prices of the patented specialties bring the first cost of a vapor system up nearly, if not equal, to that of hot water. However, one advantage obtains directly from these patented features, in that the companies controlling them insist on providing or approving plans and specifications where their materials are used, in order that they may safely and intelligently guarantee successful operation. This they do without additional charge; and their experience should go a great way toward insuring a properly designed heating system for a schoolhouse of small or medium size.

For large buildings an approved form of power vacuum system is recommended.

DIRECT SYSTEM.

While a direct radiating steam system overcomes most of the objections to a hot air furnace equipment, in common with any direct system for securing heat, it has little advantage over the stove from a standpoint of ventilation since it affords no means within itself, for providing ventilation. With such a system the open window must be resorted to, and while some still express their convictions that the open window is the sole solution of the question of ventilation, the weight of opinion is clearly against such a practice. In not a single recent important investigation has the open window solution been proposed or supported. The logic of this present tendency must be apparent, since even the most rabid advocates of open window schools admit the need of at least a little heat in the rooms; and with open windows it is not alone a question of housing children in uniformly cold rooms, but one of subjecting them to variations of temperature that may be both sudden and extreme. This, in the opinion of those best qualified to judge, is a condition that will never be allowed to prevail for any length of time, due to the disastrous results which must follow such a course.

If it is agreed that school rooms must be continuously heated, and without any regard to the uniformity of this heat, it appears that there is little excuse for installing direct radiation and placing dependence upon open windows for ventilation, since heating with admission of cold air through windows is most difficult to accomplish and requires considerably more radiating surface than is necessary with the direct-indirect or indirect systems with natural circulation. Neglecting although the increased cost of operation, it appears that the first cost of the extra radiation would be more than that of bases, dampers and diffusers for a direct-indirect system.

Of course, where windows exclusively are depended upon for ventilation the cost of vent ducts is eliminated, but this cost need be very small indeed if ducts are built directly into a new building. The installation of a direct system of radiation can be justified, if at all, only on the ground of enforced economy, and this is of doubtful accomplishment.

DIRECT-INDIRECT SYSTEM.

The application of the direct-indirect system necessitates placing the radiators along an outside wall in order to secure the outside air supply which characterizes the system. No very definite rules

have been developed regulating the size of opening and admission of air to the radiators and until recently most inlet devices were too small to admit sufficient air for ventilation of school rooms.

The principal advantages are: comparatively low first cost; a series of separate sources of heat for each room; the air is not necessarily contaminated by admission through the radiator and remains essentially as pure as its outside source; the system is not affected by winds to the same extent as the furnace system with gravity circulation, and for that reason is more efficient, more certain and more easily regulated than a furnace equipment.

With an actual opening to the outside air, such as exists for each radiator with this system, it is evident that the amount of air flowing through the opening will be dependent not only upon the difference in pressure outside and inside, created by the air inside being heated and therefore lighter, but also upon wind pressures. A strong wind blowing against the wall in which these openings are placed will cause more air to flow into the room, while a wind in the opposite direction will decrease the inflow and under exceptional conditions may even cause a temporary reversal of flow, the heated air passing from the inside outward. This state of affairs can be regulated only by judicious use of hand control.

Aside from the disturbance caused by wind which can be partially, if not wholly, remedied by regulation of dampers, the most serious difficulty with such a system arises from the fact that in calm weather it is the heating effect of the radiator which causes air to flow into the room, the amount passing in depending upon the temperature of the radiator and increasing with that temperature. Sufficient radiating surface must be installed to heat the room in coldest weather, while still admitting sufficient air changes. Some claim that this cannot be done, but if it can, it means an extraordinary amount of radiation in mild weather, and in such weather, to prevent excessive room temperatures, use must be made of some "modulating" inlet device on the radiator to reduce its temperature or part of the radiation must be shut off, either one of which will decrease the flow of air from outside, except under favorable circumstances, and may result in too few air changes per hour. A well-designed and properly-installed ventilating cowl and aspirating foul air vent flue, by their activity in tending to produce a vacuum in the room, will go far toward correcting this trouble and by intelligent use of open windows, as a supplementary scheme, may result in most satisfactory ventilation in the mildest weather for which artificial heat is required.

The importance of the vent flues, in securing ventilation, readily will be seen when it is considered that air cannot continuously be drawn into a room unless air is taken out. Heating coils placed in a vertical duct heat the air, thus causing it to rise because of its lighter weight. As this heated air in rising passes directly to the roof, all the heat used in accelerating circulation is lost so far as heating is concerned. This fact renders the aspirating coil a most inefficient scheme for moving air. Where electric current is available it should be much cheaper to lead all vent flues to a motor driven exhaust fan, located just under the roof.

In years past there has been some doubt as to the ability of this system to provide proper moisture for the air after being heated, but recently there has been developed a number of "moisteners" for attachment to the radiators or to the diffusers which are now universally provided to effectually prevent drafts.

The initial cost of the average direct-indirect steam system will probably be more than that of any of the systems previously discussed, but for almost any class of school buildings it should prove more satisfactory than any of them. Such systems are comparatively safe, economical and durable.

INDIRECT SYSTEMS.

The natural air circulation system operates on the same principle as the direct-indirect, and differs in construction only in that the radiators, which are of a special type developed for this use, are placed outside, usually beneath the room, and the cold air from outside is led through ducts to the radiating surface and then rises to the rooms through other flues or ducts. Perhaps its only important advantage over the direct-indirect is that the heated air can be admitted to the rooms at any desired height above the floor or from any wall or floor surface. The additional ducts required make the expense of installation considerably higher than that of the direct-indirect.

FORCED CIRCULATION.

Indirect heating systems with forced circulation are variously known as hot blast heating, plenum, fan blast, fan coil or mechanical warm air systems. These are but different names for what is essentially the same thing and in them all we find a blower or fan added to the usual complement of equipment in an indirect gravity system. Whatever advantages may be ascribed to the systems previously described (the fan-furnace possibly excepted), all are deficient in supplying the positive ventilation assured where the blower is added. No system of natural circulation can give absolute assurance of adequate ventilation in an auditorium or in any room occupied by a large number of people.

Many devices in the way of attachments and auxiliaries have been developed to perfect the results obtained with this system. These auxiliaries include air washers, humidifiers, cooling coils, and automatic thermostatic and humidity control equipment. Where proper air washers or purifiers are operated in connection with this system, it has been found possible to recirculate air from the building, rather than take it from outside, and still obtain perfectly satisfactory ventilation. The quality of this recirculated and washed air is superior to that often obtained from outside where dust and dirt may abound in the source of supply, as in the case where the inlet is taken from a crowded city street. The practice of recirculation will frequently reduce the cost of coal from 30 to 50% but where the source of supply is outside the cost of fuel must necessarily be high. Electric power for driving the blower is desirable, but a low-pressure steam engine operating from the system's own boiler may be employed. Wherever basement rooms are used as school rooms, some form of fan circulation is necessary, if ventilation is to be positively secured, and in such buildings, of medium or large size, it is recommended that a fan coil system be installed where the original cost and operating cost are not prohibitive.

As sometimes designed, the use of automatic temperature control devices makes closed windows a necessity since the opening of windows in one room and the attendant drop in temperature will produce overheating in another room, and while a real source of trouble in some buildings, it is evidence of a defect in design rather than in principle. The regulation of humidity, where humidifiers are used, is a matter which must receive almost continuous intelligent attention. Thermostats likewise require frequent expert attention, if they are to be kept in working order.

The real source of trouble with the forced circulation system of heating and ventilation arises through ignorance and lack of instruction of caretakers and teachers. With co-operation between teachers and plant operators, and intelligent supervision, this system must eventually prove superior to all others, but its installation is useless, and cannot be recommended, unless the school authorities are willing to pay a price for attendance commensurate with the high quality and first cost of equipment and

the excellent results attending its skillful operation.

COMBINATION OR SPLIT SYSTEM.

The forced ventilating and heating system is sometimes varied by heating the rooms with direct radiation and supplying ventilating air at room temperature with a fan and tempering coils. This arrangement results in fuel economy to the extent that only the air furnished for ventilation need be heated. At times, when no ventilation is necessary, the fans and fan-coils may be shut down. Such a system will prove more expensive to install but is very generally regarded as an improvement over the full plenum system.

PROVISIONS OF THE LAW.

In analyzing the provisions of law, those provisions which, by their own specific statement, apply to but one type of heating, and those which unquestionably can be met by every form of heating, are omitted as having no bearing on the present questions. Neither is any attention given to those regulations which apply only to systems for use in old or temporary buildings.

Following are the principal provisions of the Indiana law:

a. Fresh air shall be taken from outside the building.

b. Fresh air taken from outside shall be properly diffused without draughts through each school room during school session.

c. Each school room shall be supplied with foul air flues.

d. Foul air flues supplied shall be of ample size to withdraw the foul air from each room at a minimum rate of 1800 cu. ft. per hour for each 225 cu. ft. of said school room space, regardless of outside atmospheric conditions.

e. Heaters of all kinds shall be capable of maintaining a temperature of 70° F. in all school rooms, halls, office rooms, laboratories and manual training rooms in all kinds of weather.

f. Heaters of all kinds shall be capable of maintaining a relative humidity of not less than 40%.

COMPARATIVE COMPLIANCE WITH THE LAW.

In the following table, showing the relative capability of the various systems to meet the requirements, the numbers in the first column of the table refer to the provisions of the law given above under the same number. The indications of the letters are as follows:

A. Full compliance.
B. Fair compliance.
C. Poor compliance.
D. Failure to comply.

The analysis is purely arbitrary and is based on the performance to be expected, with reasonable care, in normal operation in all kinds of weather.

NOTE: In systems where the fresh air taken from the outside serves the double purpose of ventilating and heat-carrying medium, the provision requiring *proper diffusion without draughts* is interpreted, in the following tabulation, to include distribution of heat in room.

The short-comings of the two direct systems are considered so great as not to warrant their serious consideration. A study of the various columns will indicate an increasing qualification from left to right. The requirements emphasized by the law are such as to permit a better showing by the direct-indirect heater and the furnaces than would actually be found in practice. No requirements are made for many of the points of operation in which these devices are most faulty. In so far as the provision of the statutes are concerned the direct-indirect radiator system is just as satisfactory as the indirect radiator system with gravity circulation. The fan-furnace equip-

ment complies only fairly with the second and sixth provisions of the law.

The demands as to heat, ventilation, temperature, cleanliness, movement, and humidity are then discussed at length in the report, followed by a section on costs, including initial and maintenance costs and operating costs.

regarded as an accurate measure of the air supply and distribution in such rooms. For this reason it is recommended by no less authority than the American Society of Heating and Ventilating Engineers that a carbon dioxide test of proper supply and distribution be applied; yet, no such provision is made by the law.

RELATIVE CAPABILITY OF SYSTEM TO MEET REQUIREMENTS.

Provisions	Direct Systems		Direct-Indirect Systems		Indirect System Natural Circulation		Indirect System Forced Circulation	
Law	Stoves	Radiators	Heater	Radiator	Furnace	Radiator	Furnace	Coil
1	C	C	B	B	B	B	A	A
2	D	D	C	B	C	B	B—	A
3	A	A	A	A	A	A	A	A
4	C+	C+	A	A	A	A	A	A
5	A	A	A	A	A	A	A	A
6	C	C—	B	B	B	B	B	A

The various systems are then classified according to the type of building.

CONCLUSIONS.

1. While the law requires a heating capacity sufficient to maintain an indoor temperature of 70° F. in all kinds of weather, it does not specify any maximum temperature limits; and this condition exists in spite of the fact that the injurious effects of overheating constitute the only undebated issue regarding ventilation.

2. No provision is made as to the point, or number of points, at which room temperature shall be observed during school hours. Thus, no specific plan is laid down for ascertaining that the temperatures are proper and uniform throughout the room.

3. It is compulsory that air be taken from outside, but no provision is made against the use of air containing excessive dust particles or other impurities.

4. While carbon dioxide in the air in quantities likely to occur in a school room, cannot be considered injurious to health, its presence in occupied rooms

5. While the excellent qualities of the fan-coil system are recognized, it is readily admitted that conditions are not such as to warrant its use in all cases. Many times its cost renders it entirely prohibitive. In such cases the direct-indirect system offers the best substitute, considering both cost and results, since this system yields results practically equal to those obtained with the gravity indirect and, in general, possesses more commendable features than any other, excepting only the fan-coil system.

6. Evidence is lacking to show that as a permanent equipment for schoolhouse heating and ventilating, a well designed and constructed system of a theoretically poorer type will render better satisfaction than a poorly constructed, cheap system of a theoretically better type. Furthermore, a mediocre type of apparatus, when given careful, intelligent attention, will yield more satisfactory results than can be attained with the finest system in the hands of an ignorant and inexperienced operator.

7. Finally, selection of all equipment and attendants should be made with the idea of safeguarding the expenditure of

public money and the loss of property, and, more especially, the health and lives of school children.

The findings of the report have received the endorsement of a number of prominent engineers, including Professor J. D. Hoffman, of the University of Nebraska; Professor John R. Allen, of the University of Michigan; Professor A. C. Willard, of the Illinois State University; S. A. Challman, commissioner of school buildings of the University of Minnesota; Professor J. L. Mowry, of the University of Minnesota; and Professor Frank C. Wagner, of the Rose Polytechnic Institute.

Radiation Requirements under Varying Temperature Conditions

With Chart Giving Graphic Solutions for Use in Weather Above and Below Zero.

By EDWARD B. JOHNSON, C.E.

There are a number of preliminary considerations which present themselves when undertaking the design of a steam heating system and among them none is more important than the relation of outdoor and indoor temperatures and the amount of radiation installed. When so-called standard conditions are to be met, 70° F. room temperature with zero weather outdoors, no difficulty will be experienced and this covers the majority of cases. But when either one of both of these temperature limits are varied, we are liable to get into difficulties.

Varying the lower limit only should cause little trouble if it be remembered that in this case the amount of radiation is proportional to the temperature rise desired. Thus, assuming 0° to 70° F. as requiring 100% of radiation, 20° to 70° would require 71.4%.:

$$\frac{70-20}{70-0}=\frac{50}{70}=71.4\%.$$

And for −30° we would require 143%:

$$\frac{70-(-30)}{70-0}=\frac{100}{70}=143\%.$$

That is, if the radiation has been computed for standard conditions and it is desired to alter our computations in order to satisfy the altered outdoor temperature of − 30°, simply multiply by 1.43 the radiation for each room and the desired result is obtained.

But when the upper limit (room temperature) is varied, we immediately add to the problem the variable factor of radiator efficiency, due to the changing temperature of the air surrounding the radiating surface. The term efficiency, as here used, refers to the variation in the amount of heat radiated to the surrounding air from the heated surface as the room temperature varies. This amount is approximately proportional to the difference in temperature between the steam (or hot water) in the radiator and the room.

Table 1, Column 2 gives these amounts for every 5°. Column 3 gives the pounds of steam condensed per hour, and Column 4, the relative tax on the boiler. This table shows that a radiator standing in, say, 50° still air produces a tax on the boiler equal to about 18% more than it would had the surrounding air been at 70°, a very important fact, as extra boiler capacity to this amount should here be provided.

Assuming that each square foot of radiation standing in still air at 70° condenses ¼ lb. of steam per hour and steam at 220° F., this would equal $965 \div 4 = 241$ B.T.U. per hour. This is generally taken as 240 B.T.U.

The difference between the room and steam is $220° - 70° = 150°$ and the

B.T.U. radiated per square foot per degree difference of temperature is 240 ÷ 150 = 1.60. This is called the heat emission factor.

C. A. Fuller, in his article on "Heat From Radiators at Different Temperatures," (THE HEATING AND VENTILATING MAGAZINE for March, 1915), states that this heat emission factor is not absolutely a constant, but varies with the temperature difference between the steam and the room, increasing as the difference increases and, of course, diminishing with a smaller difference by an amount equal to 1/5% for every degree above or under 150° difference.

Consider these conditions: Steam 240° F., room temperature 50° F. 240 — 50 = 190°. This is 40° in excess of 150° difference. 40 x 1/5 = 8%. As 190° is greater than 150° standard difference, 8% is to be added to 1.6, making the heat emission factor, under these circumstances, 1.73.

Then 1.73 × 190 = 329 B.T.U., the heat transmission per square foot of heating surface per hour under the above conditions. Considerable difference, as compared with 240 B.T.U. for standard conditions.

The third condition mentioned, when room and outdoor temperatures are both varied, will not be considered here, as it is taken up later.

All of this is very fine for the mathematically-inclined, but most engineers prefer to arrive at results with the minimum of figures, thus saving time and tending to eliminate possible errors. Therefore, a table or curve which will give the result graphically of a complicated problem is almost universally acceptable.

Fig. 1 has been drawn to assist in the easy solution of the above problems and probably of others which the reader may discover.

Let us consider the first case previously discussed, when the outside temperature is varied. Upon the right side of the curve will be found outdoor temperatures from—30° to 40° F. At the top are room temperatures from 40° to 130°. The curves represent varying percentages of radiation installed, the 100% curve indicating conditions when the correct amount is installed to heat the room to 70° in zero weather, as will be seen by its passing through the intersection of these temperatures. The 80% curve then would indicate the relation of outdoor and room temperatures when 80% of the correct radiation has been installed.

To answer our problem find the desired outdoor temperature at the right and follow this horizontal line to its intersection with the 70° vertical line

TABLE I—STEAM RADIATORS—HEAT TRANSMISSION PER SQUARE FOOT SURFACE WITH STEAM AT 220° F.

Room Temperature— Deg. F.	B.T.U. Per Hour	Pounds of Steam Condensed Per Hour.	Relative Boiler Tax.
130	127	0.132	52.6
125	135	0.141	56.2
120	144	0.150	60.0
115	153	0.159	63.8
110	162	0.169	67.5
105	171	0.178	71.2
100	180	0.188	75.0
95	190	0.198	79.2
90	200	0.208	83.3
85	210	0.218	87.5
80	220	0.229	91.7
75	230	0.240	95.8
70	240	0.250	100.0
65	250	0.260	104.2
60	261	0.272	108.8
55	272	0.283	113.3
50	283	0.295	117.9
45	294	0.306	122.5
40	305	0.318	127.1

(room temperature) and the desired percentage is read off upon the intersecting curve.

Assume that the amount of radiation is desired to heat a room to 70° during —20° weather. Following the above directions, we read off 128%.

If the room temperature varies: by picking out the desired room temperature at the top of the curve and finding its intersection with the zero line (outdoor temperature) the percentage of

In the same way, when both limits vary, find the intersection of the required room and outdoor temperatures and the required percentage of radiation is read off directly. Thus, 90° room temperature and — 15° outdoor temperature intersect at 180%.

Now suppose an owner is having sufficient radiation installed to meet standard conditions, but there is a possibility of the thermometer dropping to — 20°, to take an extreme case. He

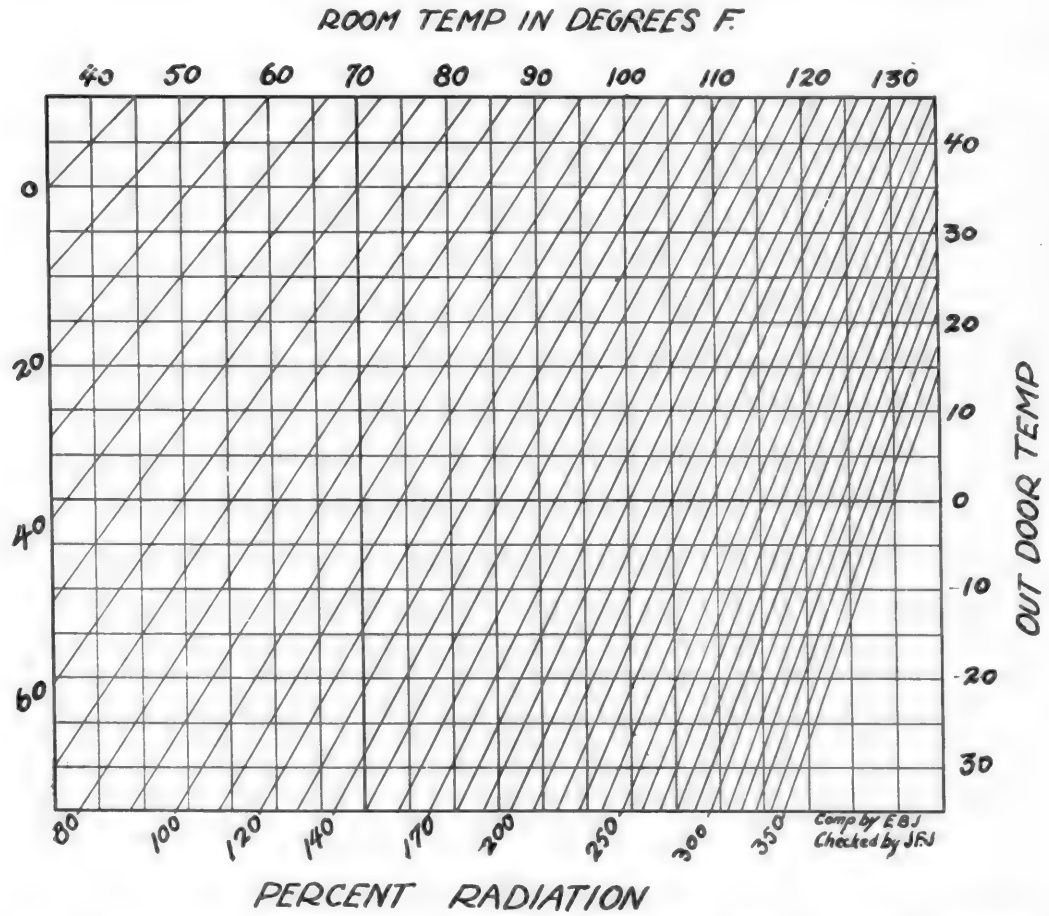


FIG. 1.—CHART FOR FIGURING RADIATION REQUIREMENTS WITH VARYING OUTDOOR AND INDOOR TEMPERATURES.

radiation required is readily read off. For example, 40° room temperature and zero outdoors. The 40° vertical and zero horizontal line intersect at a reading of 45%. If 500 sq. ft. were needed for the room under standard conditions.

$$500 \times \frac{45}{100} = 225 \text{ sq. ft. would be}$$

needed, under the above conditions.

would like to know what temperature he could probably maintain in the rooms. Follow the 100% curve down to its intersection with the horizontal — 20° line. Read the corresponding room temperature at top. The owner could, therefore, heat the house to 58°.

We will suppose, also, that the job is completed and we would like to know whether the building could actually be

heated to 70° in zero weather. Heat the building until the room temperature has become stationary. Read the indoor and outdoor temperatures, find their intersection on the curve, as described. Follow the curve to its intersection with the horizontal zero line and read the corresponding room temperature at the top. If 70° or more, all is well, but if less than 70°, the radiation is probably insufficient.

In making use of the table and chart, it should be noted that they are for steam heating calculations only.

The Transmission of Steam Heat from Central Plants

By W. H. PEARCE, M.E.

The history of steam transmission is so interwoven with the history of the steam engine that in order to convey a general idea of the circumstances and conditions under which the art has advanced, a review of one necessarily involves a review of the other. A man who recently received his university diploma stated that "the greatest advance in steam engineering has been made during the last ten years and that those who had not had the advantage of a thorough training in recent practice were behind the times." Nowadays, general public opinion appears to consider the achievements of such men as Newton, Watt, Hornblower, Newcomen, Papin, Murdock and Threventhick as mere incidents of a past age and that American genius, especially that of the present time, has accomplished a large part of all that is of value in the art; therefore a review of some of the prominent facts of history may be briefly set forth.

Without giving consideration to the early steam devices it is conceded by the best engineers that the real discovery of the force of steam was when scientific investigation was made to determine why a certain tea-kettle lifted its lid when the spout was plugged, and the means undertaken to make that force serve mankind. The tea-kettle was the first boiler, the spout the first transmission pipe, the plug the first valve and the lid was the first pressure indicator. These four elementary essentials always are found in every steam plant.

The greatest credit for discovery and advancement in steam engineering should be given to Watt, a Scotch scientist and instrument maker, who associated himself with Boulton, a capitalist. They constructed the large foundaries and shops, commonly known as the Soho Works, at Birmingham, England, where, long before some of our inventors saw the light of day, great engines and steam plants were planned, contracted for and constructed. Associated with these works and contributing to its many achievements were other distinguished men of the times, so that the history of "Soho" is largely a history of steam engineering.

One hundred and forty years ago Watt, with his acquired genius, qualified the various conditions of steam, gave us the steam-engine indicator, and the condenser. He adapted and used the poppet valve which is now considered one of the last achievements in American engine building. The Soho Works later advanced so far in the art that one of their engines was operating a few years ago on 12 lbs. of water per horse power which bears favorable comparison with the best practice of today.

It is also well to remember that the building of steam engines developed the tools for the shop;—the slide rest took the place of the hand tool;—the planer took the place of the hammer and chisel. The first iron planer bed

had its ways chipped and filed to true alignment by the hammer and chisel process which may indicate to those accustomed to modern appliances the mechanical skill of the workmen of one hundred years ago.

Not only was steam transmitted to auxiliary engines and for other general uses but also the transmission of hydraulic power was given attention. It has since been brought to such a degree of usefulness, especially in high-pressure work that some of our engineers might advantageously review their efforts on which so much money has been spent.

Murdock having knowledge of the value of coals and the transmission of steam saw greater profits in the extraction of gas from coal and selling it as an illuminant. This he accomplished after first convincing the credulous laymen of its possibilities, by illuminating his own house, thereby opening up the gas industry and the manufacture of many commodities from its by-products.

In general terms it may be said that for many years Americans were not advanced in steam engineering practice to as great an extent as their European cousins. Not that they lacked ingenuity, but the conditions did not warrant its study. There was no need of a compound locomotive since our eastern railroads then ran through a wooded country where cord wood could be had for the chopping. Our boats stopped to "wood-up" at any convenient landing. The cumbersom slide-valve engine and wood-burning boiler, carrying 40 lbs. of steam, served our purpose, while we busied ourselves in producing the best axes, buck-saws, mowers and other tools suitable to our agricultural requirements. As our workshops and population gradually extended westward, New England began to use anthracite coal and such States as Ohio, Indiana and Illinois became dependent upon the coal underlying their lands. Then, as the question of greater steam economy became a matter of interest, George Corliss designed and produced his four-valve engine which has become known and reproduced, with modifications, by almost every engineer in the land.

CENTRAL HEATING SYSTEMS KNOWN A CENTURY AGO.

It is not necessary to call to the minds of old mechanics that our shops were steam heated from central plants, and that steam was transmitted in pipes, either incased in brick or wooden boxes, to the various buildings for use in steam appliances, such as steam hammers, auxiliary engines, etc. Therefore, the idea that we are pioneers in steam transmission is an error, as the boiler, the pipe, valve and gage have always been inseparable. The numerous records in the Patent Office clearly indicate that the practice of transmitting steam is old, from the fact that patentees, prior to the year 1800, illustrated this art and asked for patents on devices and fittings which were to be applied to heat transmission pipes and heating systems.

About the year 1878 Prall, a steam engineer of Washington, D. C., proposed a system of district heating in which the novel feature consisted in transmitting high-pressure hot water to the buildings where it was to be expanded into steam at the radiators. The condensate was released by a thermostatic trap connected with a return pipe to the pump at the power house, substantially like many installations of to-day. A description of this system may be obtained from Mr. Prall's patent of October 1, 1878 and re-issued April 17, 1888.

Holly, a contractor for town and village water-works plants, undertook to transmit steam underground for the purpose of keeping hydrants from freezing, to remove snow from the streets, to keep the boilers of a steam engine ready for duty and to run engines in workshops. He proposed to maintain a pressure of 40 lbs., the steam to be exhausted at 20 lbs. into a secondary main and carried thence to other buildings for drying and heating purposes. Should the pressure in the secondary main become more or less than 20 lbs., the difference was to be made up by means of an equalizing valve mechanism. A more detailed description of this system may be found in patents granted to Mr.

Birdsill Holly, July 17, 1877, and June 27, 1882.

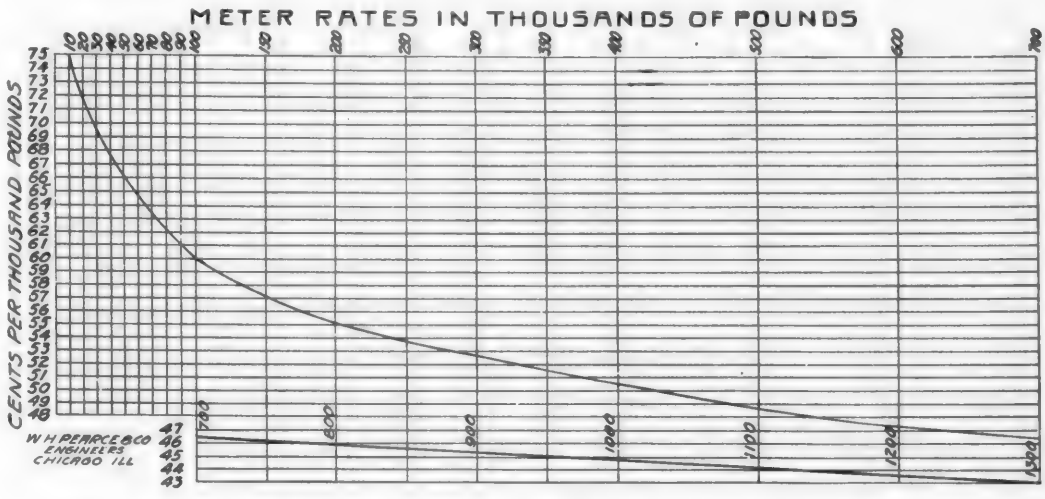
The failures of some of the first district heating plants created such an impression on investors that for many years what is now being recognized as a practical art received but comparatively meager consideration. However, numerous plants have since been installed and the industry has been revived to the extent that a large number of our cities now have commercial central heating plants, and while, in some cases, it is frankly admitted by the managers that the plants are not profitable, others have made such improvements and adapted such devices as to point to permanent success.

In connection with the failures referred to, a number of commercial plants have been erected without sufficient knowledge of the art. Speculation also has done and is still doing its share to offset the skill of the special engineering talent necessary, by constructing cheap plants rather than those of durable character.

Space does not permit of a full description of the various devices now being adapted in district heating work, but among them none is of greater importance than the perfected meter which weighs and registers the amount of steam used by the consumer. In this connection the accompanying chart has been compiled by the writer containing a scale of rates which have been widely approved as furnishing an equitable basis of charging for steam heat service.

The perfecting of steam and condensation meters, together with apparatus used for cooking, providing hot water for domestic purposes, means of heat control, etc., have placed the art on a profitable basis in providing means for utilizing all the heat units delivered to the customer. Hence 1,000 lbs. of steam may be delivered at a fixed cost and its sale guaranteed by an attractive price, while a good margin of profit is left to the investor.

One of our leading scientists made the prophecy a few years ago that "the time will soon come when the great soft coal deposits underlying our Middle Western States would have to be scientifically employed by municipalities for power and heating purposes, from central plants." Judging from the present prices of hard coal at $10.00 a ton, it would seem that the time he referred to has arrived.



SCALE OF METER RATES FOR STEAM THAT WILL GIVE EQUITABLE RESULTS.
(Based on Coal Prices Prevailing Previous to the Present War.)

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IT IS seldom that the value of a trade convention has been so strikingly manifested as was the case in the recent meeting of the central station heating engineers. Within recent months the district heating industry has been placed in a most critical situation and one calling for immediate action. Coal, the principal commodity, which all along had been thought to be fairly fixed as to price, has soared to unheard-of heights, with no assurance that future deliveries could be relied on at any figure within reason. A raise in heating rates was the obvious answer, but the travails of such an effort, not only with the utility commissions, but with the consumers, was a thing that made more than one company hesitate. It is a matter of fact that, at the opening of the convention, there was a marked uncertainty on the part of the members generally as to whether they should re-open the rate situation or postpone action in the hope of a return to normal conditions in the coal trade.

Not only that, but the companies were equally uncertain as to whether they should not lay in their coal supply, even at present prices, for fear of a shortage next fall. Last winter's experience had brought home this danger to them all, and there was at first considerable sentiment in favor of such action, in spite of the almost ruinous prices prevailing.

Long before the discussions had been concluded, it was plain that the sentiment of the convention had been crystallized and that there was more than substantial agreement, first, that rates must be raised, based upon the higher cost of all the principal items involved, and, second, that coal purchases for the winter supply should be held in abeyance. On the latter subject, convincing evidence was presented of wholesale manipulation of coal prices which left no room for doubt that the bubble could and would be pricked.

It is possible the companies would have reached this decision in any event, but it is certain that the meeting and exchange of views brought the matter to an immediate issue and to a settlement that was practically unanimous.

HOW rapidly the movement for compulsory ventilation is advancing may be seen from the codes that have gone into effect since 1914, when the laws covering public buildings generally were reviewed in these columns. Since that time the Illinois school law has become effective, the Minnesota rules have been entirely rewritten and amplified, the New Jersey "Stokes" law has been supplanted with more detailed requirements and, finally the Vermont regulations have been entirely revised and extended to cover picture theatres. Measured by results, the advance has been altogether gratifying.

NATIONAL DISTRICT HEATING ASSOCIATION

Ninth Annual Convention, Detroit, Mich., June 12-15, 1917

"Raise your rates," with no two ways about it, was the slogan of the National District Heating Association at its ninth annual convention in Detroit, Mich., June 12-15. The seriousness of the coal situation was brought home to the member companies with the greatest of emphasis and, while substantial and early relief was predicted in connection with the coal supply, yet it is beyond question that the quotations for coal for a long time to come will be above those on which most of the heating rates are based. This factor, taken in conjunction with the higher costs of labor and materials, will make a raise in heating rates imperative, if the central heating industry is to continue as a profitable industry.

If ever the holding of a convention at a critical time was justified, certainly this one, which awoke the members to the seriousness of the rate question, was justified on that score alone. Many of the members, it developed, were uncertain as to their action until hearing the

THE COAL RESOLUTION

WHEREAS, The excessive and exorbitant prices now being asked for coal is causing loss and hardship in our country; and

WHEREAS, Heating is the most essential of the comforts and necessities of humanity;

This Association does hereby ask that the government of the country and its officers and committees take such steps as will compel the great coal industry to market its product at such prices as will give a fair and reasonable return upon the cost of production and at the same time will not injure nor destroy legitimate business in our country;

And that the great transportation companies be urged to arrange to deliver coal as a preferred commodity;

And that we further urge that all associations and utilities assist the government and its officials in bringing about such adjustment of prices for fuel as will be equitable to all parties concerned.

THE RATE RESOLUTION

WHEREAS, The high cost of operation covering all branches of the heating industry has seriously affected that industry; and

WHEREAS, In order that the industry may live, it is necessary that such steps be taken as will take care of the present costs in the industry; therefore be it

Resolved, That the association offer its services and pledge its support to any heating utility that desires to legally increase its rates to such point as will afford a fair and reasonable return upon the property used and useful in the business; be it further

Resolved, That we urge all heating companies to take the necessary legal steps before their several courts and commissions as will permit such prices as will give such return.

reports presented in convention and it is safe to say that none went away without a realization of the necessity and urgency of the proposed step. The accompanying resolutions show how this and the fuel questions were handled, the association pledging its services in helping the companies to supplement its present rate schedules.

Morning Session, June 12.

Delightful summer weather ushered in the opening session which was held on the twelfth floor of the Hotel Pontchartrain. Mayor Oscar B. Marx, of Detroit welcomed the delegates in person, the response being made by George W. Martin, first vice-president of the association.

The report of the executive committee was presented by Secretary D. L. Gaskill. It was recommended that all members in the service of their country have their dues remitted. This recommendation was adopted. Some twenty candidates were elected, including a large representation from New York.

PRESIDENT'S ADDRESS.

President Byron T. Gifford, in his address paid a warm tribute to the work of the standing committees and urged a greater use of the columns of the Association's Bulletin in the accomplishment of their work. He bespoke greater efforts on the part of the members in increasing the ranks of the association, declaring that there should be at least 600 active and associate members instead of the 400 now on the rolls.

There is an impression abroad in many quarters, declared President Gifford, that the central station heating industry is not getting proper returns; in short, that central heating does not pay. As one investment banker declared when approached in connection with a district heating proposition, "we are exerting our efforts along other lines."

"Our duty, it seems to me," said President Gifford, "is to show the investing public that money can be made out of heating plants, and we cannot expect money to come to us until we can show good net returns. The longer the present impression exists the more difficult it will be to change this impression, but if we can change it and show the proper value of our business as a place for safe investment, money will come to us and the entire complexion of our business will be changed.

"If your heating plant does not pay proper returns, first get a complete statement of what it is doing and then look for the cause of your trouble. This cause can be in only three places: 1, low rates; 2, high fixed charges; 3, bad operating conditions.

"Examine carefully the operating conditions. There are very few members of our Association who do not know how to put these things right.

"Next examine carefully your fixed charges. It is true that it is very difficult to reduce fixed charges but it can be done. Why not increase the capacity of your equipment and do more business by arranging to increase your boiler capacity with improved stokers, a water-softening plant, forced draft, or by rearranging the baffles in your boiler? If your pipe line is small, why not increase the pressure on the line? Why not send out steam at 20 lbs. instead of 3 or 5 lbs.? Is there any good reason why 5 lbs. back pressure is your limit or is the most economical operating point?

ADVANTAGES OF EXHAUST STEAM OVERESTIMATED.

"This brings us to a very interesting feature of our business. Why not sell high pressure steam? If you are receiving the proper price per unit for your service you are making some profit on each unit, provided, of course, your overhead expenses or fixed charges are not eating up this profit. If you are receiving the proper price per unit. why not sell twice the number of units with practically no increase in fixed charges? You are certainly reducing your overhead ex-

penses in this way. But you may say, 'How about the exhaust steam? We cannot use exhaust steam if we sell high pressure steam.' I will answer that by saying that you do not need exhaust steam. In many cases the amount of money that you make out of the combination operation is nothing compared with the saving you could make by reducing your fixed charges. In other words, the advantages of exhaust steam have, in my opinion, been overestimated. There are cases where the increase of business cannot be obtained due to local conditions and where the pipe line is already built and the investment made. In that case the by-product with the sale of exhaust steam is probably the best solution of a rather bad situation. There may be some cases where none of the above suggestions will help. In that event examine carefully your rates.

GEORGE W. MARTIN, NEW YORK
President National District Heating Association.

"But such consumers as hotels, cafés, laundries, barber shops, Turkish bath rooms, hospitals, etc., in other words, consumers needing high-temperature steam cannot be served as well by any other system.

"There may be some cases where none of the above suggestions will help. In that event examine carefully your rates.

"If you can teach your consumer to practice economy in the use of heat you will have no trouble increasing his rate per unit. If he is not economical in the use of heat, it is as much your fault as his. He can afford to pay you a living rate if he practices the proper economies. Central heating is fundamentally sound and it is economically sound.

"I appreciate fully that it is no simple step from a financially unprofitable heating plant to one earning dividends. It is not a simple matter but it is certainly a possible one. There are some plants and systems that would probably never pay and in that case the blame should probably be put upon the original builders, yet they were doing what they thought was right at that time. What should be done in a case of this kind is to build a new plant along the right line and take a cold bath as far as the present plant is concerned. If a plant is actually losing money, there is no sane reason why its operation should be continued. It will probably be difficult to interest any one, with a plant of this kind, to make additional expenditures but, as a matter of fact, it is either that or lose what they have already.

"It is my opinion that the heating business must stand on its own foundation and that we must not expect it to be maintained as a by-product to the electrical plants, although a heating plant will materially increase the field of the electric plant.

APPOINTMENT OF "ADVANCEMENT COMMITTEE" URGED.

"My suggestion to you is to appoint a committee to be known as the 'Advancement Committee,' this committee to study carefully the operation of existing plants with the view to learning just what is needed to put our heating plants

on the proper basis.

"Let the personnel of this committee be such as to inspire confidence and to insure hard and conscientious work.

"Hot water central heating plants have operated successfully and I believe can be made to be more successful with a few developments and improvements. The one crying need of this branch of our business is a suitable consumer's meter."

SECRETARY-TREASURER'S REPORT.

The report of Secretary-Treasurer D. L. Gaskill showed receipts for the year, including the $311.14 balance left over from last year, of $6,391.68. The total expenses were $6,439.34, leaving a small deficit of $47.66. The accounts receivable, however, amounted to $1,-143.75.

The total membership is now 387 showing a gain over last year of 31 members.

President Gifford appointed the following as a nominating committee: A. C. Rogers, chairman; H. A. Austin and A. W. Higgins.

The session concluded with the consideration of a number of proposed amendments to the constitution, all of which were adopted unanimously. The amendments related to the election of members by the executive committee, instead of by the convention; to the dues which were readjusted, and to details regarding the election of officers.

Afternoon Session, June 12.

The first speaker at the afternoon session was Professor John R. Allen of the University of Michigan who delivered a most interesting address on "The Fundamental Laws of Heating."

In discussing Prof. Allen's address it was brought out that the load factor is an important element in connection with continuous and intermittent heating. If a large amount of steam is to be used in the morning for warming up purposes, continuous heating would prove more expensive to a central station heating company on account of the low load factor for lighting at that part of the day.

J. C. Hornung advocated the lowering of the indoor temperature during the night to 55°. With this arrangement the savings for continuous heating will run from 20 per cent to 30 per cent. In closing the discussion, Professor Allen approved of this practice.

In response to a question as to recent experiments conducted by Professor Allen regarding the "best" location for a radiator in a room, Professor Allen stated that with the use of an electrical unit to supply heat to the radiator it had been possible to measure the heat transmission in watts. These later tests, he said, which have been conducted during the past winter, have made it appear that the radiator is, after all, more efficient when placed under the windows. Previous experiments, reported at last summer's meeting of the heating engineers' society, had shown that at a point near the inside wall the radiator had shown the greatest efficiency.

President Gifford took this occasion to mention the plans for closer co-operation between the American Society of Heating and Ventilating Engineers and the National District Heating Association. These, he said, included joint committee work and possibly a joint meeting of the two organizations.

REPORT ON STATION OPERATION.

The report of the station operating committee which was then presented, was a lengthy document compiled by a committee headed by Jay Grant DeRemer, chairman. The topics covered included feed water treatment, furnace design and insulation of boiler walls, bonus systems in the boiler room together with a discussion of methods for determining the best ratio of heating and electric loads in connection with district heating and electric systems, the report concluding with a brief account of re-

cent progress in station development.

A lively discussion followed the reading of this report, the point being emphasized strongly that a tremendous opportunity awaits the plant manager in bringing his employees together for discussions of their problems. A. C. Rogers told in detail of the steps in this direction taken by the Toledo Railways & Light Company and stated that previous reports of the association's station operating committees had been very useful in furnishing topics for discussion and in stimulating interest.

Secretary Gaskill told of similar work carried on by committees of the Ohio Electric Light Association, the practice being to gather the men together within a small compass geographically and have them addressed by a member of the association's committee, who was always reimbursed for his expenses in this connection.

ASSOCIATION PLEDGES SUPPORT TO GOVERNMENT

On motion made by George W. Martin the association adopted the following resolution:

"WHEREAS, The President of the United States has called attention to the depressing effects on the whole country of the discontinuance or lessening of the regular activities in various fields of business, and

"WHEREAS, Emphasis has been placed on the importance of stimulating food production for the needs of this country and our Allies; be it

"Resolved, That it is the belief of the members of the National District Heating Association, assembled in convention in Detroit, that it is also of paramount importance that conditions in the central station heating industry be preserved at or as near normal as may be consistent with the present state of labor and coal supply; and be it further

"Resolved, That the members of this Association pledge their aid to the Government in helping to solve any engineering problem in which their experience may be of value."

It was brought out in this connection that the recent appointment of the committee consisting of Davis S. Boyden, Charles R. Bishop and George W. Martin had been made at the express request of the Quartermaster-General's office in Washington to confer with the War Department regarding methods for heating the sixteen army cantonments, soon to be established at different points. While no decision was reached at the conference, held in Washington in May, it was learned that the heating requirements will involve the equivalent of 12,000,000 sq. ft. of direct radiation which would cost over $11,000,000.

This concluded the technical program for the day and the remainder of the afternoon was spent in the exhibition hall.

Morning Session, June 13

The first paper at the Wednesday morning session was contributed by Nelson S. Thompson, chief engineer for the office of the Supervising Architect, Treasury Department, Washington, D. C. Mr. Thompson had intended to describe the new government central heating plant in Washington to supply heat, power and electric light to twenty-one buildings in the capital.

Owing to war conditions the contemplated paper had to be laid over until after the war. Instead Mr. Thompson took up the operating costs in several government buildings in Washington, including the District Building, the new Washington Post Office and the National Museum group.

It was decided to publish this paper, which was read from manuscript, in the July issue of the association's Bulletin.

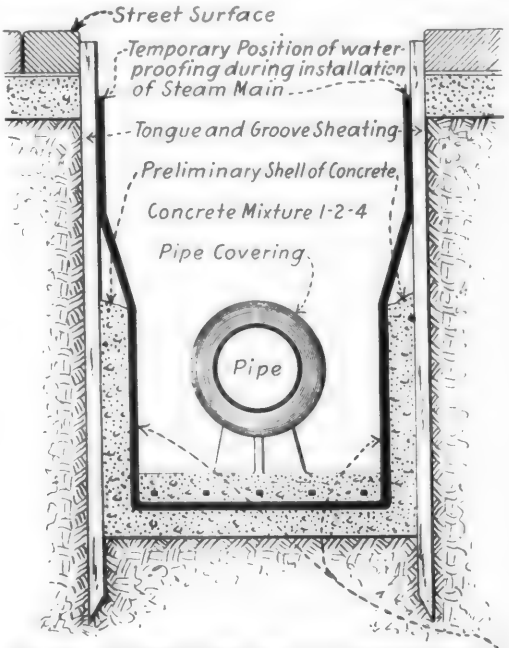
Professor J. D. Hoffman, of the University of Nebraska, then delivered an address on "A Study of District Heating in the Central West." Professor Hoffman devoted his address to conditions and the future outlook in Nebraska.

After referring to the prosperity that had come to the farmers of this section of the country, he described the evolution of farming methods which had brought in the use of machinery for all of the principal farm operations. With this development had come what Professor Hoffman termed the "misrepresentations" of machinery manufacturers which had led to many installations that were inadequate from an engineering standpoint. Nebraskans, he said, are slow to forget such things and the manufacturers do themselves a grave injury when they permit other than reliable apparatus to go in. Professor Hoffman spoke particularly of a case where the manufacturers' estimates of the capacity required in a boiler for a high school building varied from 75 per cent to 100 per cent. It was evident, he said, that if the lowest capacity boiler had been installed it would undoubtedly have been inadequate, with the possibility of a lawsuit. But the possible loss to the manufacturer, he said, in such an event, would have been small compared to the loss in prestige that would be experienced by that manufacturer. Professor Hoffman reported an analysis made of power plants in Nebraska which showed a total of thirty-eight power and lighting plants in the state. Of these twenty-two are steam plants, fourteen gas and oil, one steam and oil and one water power. Fourteen of these plants supplied heat. He said the tendency was toward the use of steam, rather than hot water, for heating.

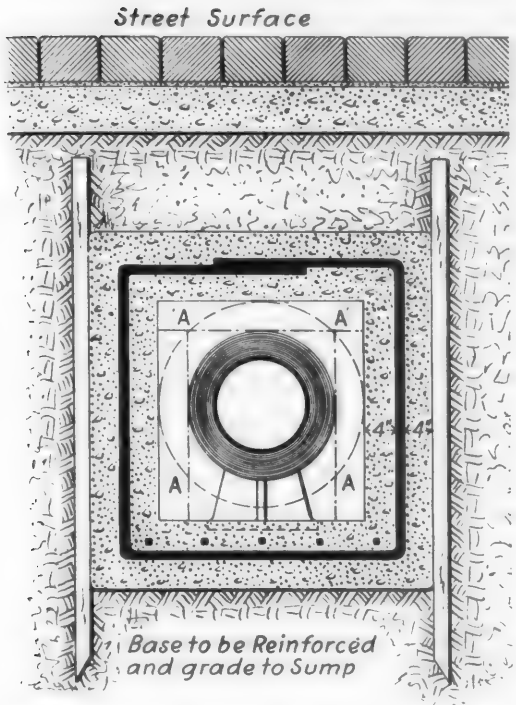
Professor Hoffman made an important point when he stated that few cities and towns have community plans in view. As a rule there are no engineers on the town boards. Every town, he said, on reaching a certain size, should call in engineering advice with the express purpose of developing a community plan, so that there would be a comprehensive idea worked out for municipal improvements, including central heating service, as well as a co-ordination of such plans. He predicted that the community plan would be the next step in the government of towns and cities.

The report of the Underground Construction Committee was presented by H. A. Austin, chairman. This report dealt particularly with the waterproofing of underground steam and hot water mains. Illustrations were given of the methods used by the Interborough Rapid Transit Company in the subways in New York City, consisting of alternate lapped layers of tarred roofing felt, or burlap, and asphaltum as the waterproofing proper. Similar materials were used to form the waterproofing envelope surrounding the steam main installation proper of the New York Steam Company where the heating mains are located below mean high tide level.

A statement made in the report that leakage of water through the waterproofing brought out a rejoinder from E. B. Tyler that several of the railroads could show examples of waterproof construction. President Gifford stated that he had never seen a waterproof line. It


Street Surface
Temporary Position of waterproofing during installation of Steam Main
Tongue and Groove Sheating
Preliminary Shell of Concrete, Concrete Mixture 1-2-4
Pipe Covering
Pipe
Four to six alternative layers of tarred roofing felt or Burlap and Asphaltum. Use only a high degree melting point Asphaltum

WATERPROOF ENVELOPE PARTIALLY COMPLETED TO ALLOW FOR INSTALLATION OF STEAM MAIN.



COMPLETED WATERPROOF ENVELOPE FOR ANY TYPE OF STEAM MAIN INSTALLATION

should be remembered, he said, that the battery boxes in railroad work are carefully constructed in unit form while in laying underground pipe lines the work of waterproofing has to be done on the spot and usually in cramped quarters.

At the close of this session C. H. Spiehler, of Dayton, who is the engineer in charge of the construction of the army cantonment at the government aviation field in Dayton told some of the details of the heating equipment. Underground wood conduit is to be used for the pipe lines. There will be two units, each with its own water plant, involving a total of 10,000 to 12,000 lin. ft. of mains. The amount of radiation to be installed in this particular cantonment will be 92,000 sq. ft.

Afternoon Session, June 13.

George W. Martin, chairman of the Educational Committee, was the first speaker Wednesday afternoon. Reporting for his committee Mr. Martin presented several matters which had been taken up during the year, including tests with a new design for a stock kettle, to be used in connection with low pressure steam cooking, by J. W. Wattles, of the Boston Edison Illuminating Co.; test on the application of superheated steam to evaporating kettles superheated by electricity, by H. R. Wetherell; a discussion of steam consumption in a hotel kitchen, by J. H. Walker, of the Detroit Edison Co.; steam consumption of a department store restaurant, by E. F. Tweedy of the New York Edison Co.; test of a vegetable and soup cooker, by H. R. Wetherell; industrial heating by surface combustion, by E. F. Tweedy; and the adopting of sprinkler systems for heating buildings.

An interesting discussion arose over the possibility of using low pressure steam at about 2 lbs. pressure for cooking as against 30 lbs. pressure, as specified by the manufacturers. Mr. Walker said the manufacturers should be urged to change their requirements. Mr. Rogers said that frequently the piping as installed makes it impossible to use high pressure steam for cooking and the installation of new piping is out of the question.

At his suggestion Charles R. Bishop told of a series of experiments carried on at the plant of the American District Steam Company which had demonstrated conclusively that cooking could be successfully done in steam kettles with the steam at 2 lbs. pressure. In fact so successful were these experiments that the American District Steam Company is about to place on the market a full line of steam cooking kettles for operation at this pressure. This announcement brought forth enthusiastic comments. In the same connection it was brought out that in Seattle the central heating plant has 150 customers who use steam for cooking. For this service a special high pressure line had been installed when the system was first put in operation, but

it was found that low pressure steam could be used successfully for this purpose, and as a result the high pressure line was discarded. All the cooking apparatus, however, was hand-made or altered to make it adaptable to the use of low pressure steam, which, in this case, was about 5 lbs.

Discussing the use of sprinkler systems for heating, one speaker brought up the point that the board of fire underwriters might object to this arrangement, due to the danger of scalding the occupants with hot water in case of fire. Ira N. Evans stated that as far as Massachusetts is concerned, where the system is in operation, the Board of Fire Underwriters had sanctioned its use.

The report of the Public Policy Committee S. M. Bushnell, chairman, was presented by Secretary D. L. Gaskill. This report took up economy among workmen, employers' liability and workmen's compensation laws, economy in the use of heating service, concluding with a discussion of rates for heating service. In the matter of rates the committee stated that "certainly in view of the advanced cost for supplies of every nature throughout the country, there should be no hesitation on the part of central heating companies in asserting their claim to at least a corresponding advance in the price of their commodity."

Before closing the session, the chairman introduced Colonel Dudley J. Hard of Troop A, Ohio National Guard, of Cleveland, who was one of the six men who founded the National District Heating Association. Col. Hard expressed his pleasure at being present and stated that he was glad the association had voted to hold its convention this year because now if ever was a time when such a business as district heating should be carried on with the highest degree of efficiency.

Morning Session, June 14.

Most of the Thursday morning session was taken up with the presentation and discussion of the report of the Heating Research Committee. This report was prepared by a joint committee, of which D. S. Boyden was chairman, representing the New England Section of the N. E. L. A. and the National District Heating Association. The report was the result of certain isolated plant discussions in which it was charged by a representative of a large manufacturer operating an isolated plant that central station companies were long on information as to electric costs and operation, and, by clever salesmanship and otherwise, solicited the electric light and power business, but, after getting the electric business, left the customer, in many cases, without any advice or assistance as to the operation of his steam heating requirements.

The information brought out in the report included detailed records of actual steam operating costs in thirty-three different buildings of various types, compiled with a view of enabling the companies intelligently to solicit the large customer and then to educate him in the economical use of his steam service. An outline was also given of the policies to be followed by the central station companies in advising, supervising or operating the customer's steam plant in the event of his adoption of central station service. The detailed information as to costs was supplemented by two condensed tables, one giving the figures for the annual unit consumption in these thirty-three buildings per square foot of floor area and the other giving the annual unit consumption per 1,000 cu. ft. of volume. The consumption figures per square foot of floor area averaged about 16 lbs. of coal and 117 lbs. of steam. The unit consumption per 1,000 cu. ft. of volume averaged about 830 lbs. of coal and 8,657 lbs. of steam. Included in the list of buildings were department stores, a municipal office building, general office buildings, hotels, hospitals, shoe factories, machine shops, a church and residence, a candy factory, an automobile and carriage factory, tenant manufacturers, and

camera, optical instrument, jewelry and carpet factories, together with a combination apartment, store and machine shop.

The remainder of the session was given up to a discussion of accounting methods for district heating companies, President Gifford and others taking part in the discussion.

Afternoon Session, June 14.

All of the Thursday afternoon session was devoted to a discussion of rates and this session was easily the most vital of the entire convention.

The discussion was opened by Secretary D. L. Gaskill who said that every member company represented had been brought face to face with the rate situation during the past six months and that the trend of affairs was decidedly in the wrong direction.

The rates of both heating and electric companies, he said, have been based too much on what someone else has done. The first step in establishing rates should be the determination of costs based on a valuation of the property, physical and intangible.

He predicted that within ten years rates would become so standardized that the matter would no longer be open for discussion, but in the meantime, with so many companies operating, under present conditions, on losing contracts, it was essential that a revision be made without delay.

It had been thought that the cost of fuel was fairly fixed, but with the unheard of advances, in recent months, in the price of coal, an entirely new situation confronted the companies.

Mr. Gaskill declared that the commissions are advancing faster than the companies in the matter of rates and he cited the recent ruling of the Ohio Public Service Commission which provides, among other things, that all contracts must conform to the existing rates, and there was no reason why the heating companies should not file supplementary schedules, which, if allowed by the commission, would become effective on all contracts for heating service.

Mr. Gaskill then spoke at length on the coal situation and expressed the opinion that rather than enter into coal supply contracts at the present prices, he would urge a waiting policy as he anticipated there would be effective relief as regards the coal situation before the heating season opened again.

Much of the ensuing discussion was of a confidential nature, but among the many points brought out was the upward jockeying of coal prices by the operators, being, it was declared, out of all proportion to the increase in the cost of mining and transporting the coal.

All of the speakers came out unreservedly in favor of an immediate raise in rates. In this connection it was stated that the same rates were not necessarily applicable in two cities of the same size, and evidence was given to show that the cost of steam production and distribution sometimes varies, in such cases, as much as 17 per cent. "You must not figure against gross dollars," declared the speaker, "but against the thermal efficiency of the plant."

Detailed evidence was presented by another speaker showing how the coal company's prices were arbitrarily raised and then lowered when it became evident the sale could not be effected at the higher figures.

As showing the possibilities in the reasonable raising of rates, President Gifford quoted from the recent decision of the Indiana Public Service Commission *re* the Frankfort Heating Company. The commission, in this case, authorized a raise in rates from 17 cents to 20½ cents, which it was estimated would give a net profit of 7 per cent on the valuation and an additional 2 per cent for a depreciation reserve fund.

It was then suggested that any proposed rate increase should not be based on the higher cost of coal alone, but also on increased labor and other costs as well.

Contracts, with coal riders, were not

generally approved of by utility commissions, and in one case it is proposed to ask for a straight percentage increase, covering the cost of coal and labor.

One speaker brought the convention almost to its feet by declaring that the present situation may mean life or death to the heating companies, that it was impossible for them to make money under the present conditions and that there was no need for further discussion—"the rates must be raised."

It was suggested that it might be possible to co-operate as an organization with other associations which are large users of fuel to effect a lowering of coal prices and details were given of steps that could properly be taken in this connection.

It was brought out that John W. Lieb, vice-president of the New York Edison Company has been appointed to a place on one of the government boards that has to do with the coal supply and that members might receive substantial aid by letting him know of their coal troubles. His headquarters in Washington are at 1111 Munsey Building. Steps have already been taken in New York to conserve the fuel supply next winter and its distribution through daily co-operation between the various interests.

The discussion closed with a stirring admonition to "Go home and raise your rates."

NEW OFFICERS.

The report of the nominating committee was presented by H. A. Austin, chairman, as follows:

President, George W. Martin, of New York.

First vice-president, J. C. Hobbs, Pittsburgh.

Second vice-president, J. L. Hecht, Chicago.

Third vice-president, O. M. Rau, Milwaukee.

Secretary-treasurer, D. L. Gaskill, Greenville, O.

Executive committee: above-named officers and W. A. Wolls, Indianapolis; J. H. Walker, Detroit; and C. A. Gillham, New York. An independent nomination was made of A. C. Rogers, Toledo, for member of the executive committee. The election, the next day, confirmed the nominations of the officers. For members of the executive committee (two to be elected) the candidates chosen were A. C. Rogers, of Toledo, and J. H. Walker, of Detroit.

Morning Session, June 15.

The report of the Meter Committee, J. H. Walker, chairman, was divided into four sections, dealing respectively, with recent improvements in steam flow meters, with special reference to the Republic flow meter; with new condensation meters, including the Mason meter and the Tyler meter; with standard tests for condensation meters; and with comparative operating data.

Three standard methods of testing condensation meters were suggested by the committee which were described as temperature accuracy tests, load accuracy tests and steam pressure accuracy tests.

George W. Martin presented the report of the committee on Valuation Terminology. He said that at a joint meeting with representatives of other associations it was decided that each organization should develop its own definitions of terms used in appraisals of public utility properties, and turn them over to a committee of the N. E. L. A. which will act as a clearing house in the work.

H. C. Kimbrough presented a map of the United States showing all of the existing steam and hot water central heating in the country brought up-to-date.

The new president, Mr. Martin, was then installed and made an address, expressing his appreciation of the honor conferred and pledging his efforts toward the furtherance of the association's interests. He declared that service was the keynote that should dominate the members.

Vice-President J. C. Hobbs was also introduced and made a suitable response.

Under topical discussions a paper by R. C. Marsh was presented on "Loss of

Heat Through Insulation," describing results obtained on a single-pipe, forced hot-water system. The test showed the temperature of the water at successive points on the system under varying conditions of outside temperature. The temperatures were obtained by mercury thermometers of the maximum type in thermometer wells filled with heavy oil.

C. B. McMillan stated that such tests were not very conclusive owing to the variation of the soil temperatures. Another determining factor is the depth of the pipes in the ground.

President George W. Martin discussed the subject of "Ash and Coal Handling Problems." Mr. Martin said that during the past winter many plants in New York were forced to burn crushed coke, owing to the scarcity of coal. Culm, or anthracite dust, was also tried, but without success. Mr. Soucy told of better success he had obtained in burning culm, and it was brought out that the weathering of the culm was an important factor in this connection. No. 3 buckwheat is now being successfully burned on the new types of Cox stokers. Ejection of ashes by steam and water was also discussed, and the new developments described.

George L. Flechsenhaar presented a topic on "Efficiency of Consumers' Installations in Relation to Central Station Supply." This paper was a general discussion of the subject, supplemented by a typical case showing the savings effected through co-operation with the consumer who had complained of what he called exorbitant charges. During the succeeding month the system was operated by the company, showing a total of 441,000 lbs. of condensation with an outside temperature of 21.6° F., as compared with a total of 579,000 lbs. the previous month with an average outside temperature of 27.9° F. This, he stated, was an instance showing the value of teaching the consumer how to operate his system for economy.

The discussion brought out the fact that the average installations in residences and similar buildings were usually skimped and inadequate so that it was important to see that better installations were made. Every poor building installation not only makes good service difficult but is a handicap on the entire central heating industry.

The convention concluded with the passage of the important resolutions already referred to, regarding the rate question and fuel supply, and also resolutions of thanks to the officers and committees and a special resolution regarding the hold-over of the associations' officers in case war conditions should prevent the calling of next year's convention.

The Entertainment.

Although the fickle weather god, who has been disturbing the elements all Spring, was still in a frowning mood, he had the grace to interfere as little as possible with the entertainment of the delegates and guests. For the first two days the weather was all that could be desired, but after that it grew colder and cloudy.

On the opening day of the convention there were card parties for the ladies and these were followed, the next day, by theatre parties.

On Wednesday evening a dinner, with cabaret and dancing, was held in the Grill Room of the Pontchartrain and proved a merry affair. Between showers of confetti and streamers of paper, all formality was soon thrown to the winds, while the scene itself, with the diners in paper caps of variegated hues and shapes, was as bizarre as one could wish. The speechmaking was necessarily short and to the point, the principal item after a toast to the President and our allies being the presentation by Secretary D. L. Gaskill of a gold medal to the retiring president, Byron T. Gifford. Colonel Hard, of Troop A, O. N. G., who was one of the organizers of the association, also spoke, being followed by George W. Martin, who was later elected president.

Thursday afternoon the ladies toured the city in automobiles and in the evening there was a theatre party for all at the Temple Theatre.

The concluding feature was a boat ride for all to St. Clair Flats on Friday afternoon, immediately following adjournment of the convention.

L. S. Shaw, as chairman of the entertainment committee, was warmly congratulated for his successful efforts in connection with the general arrangements, especially the dinner. The sub-committee chairmen who saw that their parts of the entertainment were carried out without hitch were: Card party, A. D. Spencer; moving picture show, A. G. Crocker; automobile ride, J. V. Redfield; banquet, L. S. Shaw; theatre party, William Owen; boat ride, A. G. Crocker; reception, A. D. Spencer.

The contributors to the entertainment fund included the Allis-Chalmers Mfg. Co., American District Steam Co., Armstrong Cork & Insulation Co., Central Station Steam Co., Detroit Stoker Co., General Electric Co., H. W. Johns-Manville Co., Michigan Power Co., Murphy Iron Works, Detroit Edison Co., Westinghouse Electric & Mfg. Co. and Wright Mfg. Co.

Convention Notes.

The success of the company section idea was attested by the reports from the Toledo section, which is the first city to have such a section in the N. D. H. A. A similar section has been formed in New York of employees of the New York Steam Company.

Professor John R. Allen, who was the principal speaker at the Tuesday afternoon session, came in for many congratulations on his election as dean of the College of Engineering and Architecture of the University of Minnesota, in Minneapolis. Professor Allen has been professor of mechanical engineering at the University of Michigan for 21 years. He stated that his researches and tests in connection with heating and ventilation will be continued at the University of Minnesota, a special appropriation having been made by the university at his instance for carrying on this work.

The election to membership of Nicholas P. Melnikoff, of Petrograd, Russia, was commented upon as a reminder of the possibilities in Russia that will be presented after the war.

One of the interesting movements started by the association is a roll of honor of those members who have gone to the front, as well as those who are in the service of the government in other ways. This roll will be kept on file at the secretary's office and members and others are asked to send in the name of any members they know of who are in government service.

A substantial evidence of the war business that is to come to manufacturers of central heating apparatus was the contract received by the American District Steam Company for all of the underground wood pipe casing to be installed at the army aviation camp at Dayton. This order alone amounted to $48,000.

One of the first companies to raise its rates as a result of the prevailing prices of fuel and other materials, it was brought out, is the New York Steam Company, which filed its supplementary schedule June 1, with the New York Public Service Commission. In this connection attention was called to a ruling of the commission to the effect that the approval by the commission of the new rates makes them apply automatically to existing contracts, whether or not lower rates are specified in such contracts.

Considering war conditions and the fears expressed by many of the members that the convention might better have been given up this year, the attendance of 128 active and associate members was considered remarkably good. The absence of some members was due to the loss of men in the plants, who have enlisted for active service.

Among the Exhibitors.

A total of 25 exhibits on display in the room adjoining the convention hall proved one of the most attractive features of the convention. Many new devices, as well as the latest developments in standard apparatus were shown, in some cases in operation.

Precision Instrument Co., Brooklyn, N. Y., showed types of its CO_2 recorders, Orsats, micrometer gauges, indicating and recording portable gauges for vacuum and pressure, steam, water and gas. Paul Jones, sales manager of the company, was in charge.

Minneapolis Heat Regulator Co., Minneapolis, Minn., had on exhibition different models of its heat regulators, including Model No. 55, with A. C. motor, operating on 110 volts, which has a duplex clock attachment by which it will operate at different temperatures day and night. Harold W. Sweatt, vice-president, and C. A. Scholle, Ohio representative, had charge of the company's interests.

Chapman Valve Mfg. Co., Indian Orchard, Mass., displayed one of its large self-packing valves and one with a wheel top. F. W. Sleep, New York manager, and Thomas Maher, were on hand for the company.

Detroit Lubricator Co., Detroit, Mich., showed its line of packless radiator valves, house-heating boiler safety top valves and fusible plugs and water gauges. J. S. Crane, advertising manager, had charge of the exhibit, and others present included H. I. Lord, vice-president and sales manager, and George Cage, assistant sales manager.

Chamberlin Metal Weather Strip Co., Detroit, Mich., had models of its double-hung window equipment, door equipment and casement window equipment. Those on hand for the company were J. P. Glaser, general sales manager and W. H. Stevens.

Wright Mfg. Co., Detroit, Mich., showed the Wright improved safety alarm water column, Murray feed water regulators, Austin steam and oil separators and other specialties. H. C. Van Sickle, of the Detroit office, was in charge.

Jenkins Bros., New York, had on exhibition various types of fractional valves, also Babbitt adjustable sprocket rim for valve handles, Kantsplit valve wheels, Jenkins '96 packing and Manhattan self-lubricating packing. R. B. Osgood, of the company's Chicago office, had charge of the exhibit.

Central Station Steam Co., Detroit, Mich., showed a full-size model, in operation, of the Detroit continuous-flow condensation meter, together with one of its double style A diaphragm-type expansion joints. Those present for the company included J. V. Redfield, president; W. R. Owen and W. G. Bryant.

American District Steam Co., North Tonawanda, N. Y., had an exhibit which included the Simplex condensation meter and the St. John flow meter, both in operation; also models of its underground construction for pipe lines, and the Adsco specialties for use with the Adsco system of Atmospheric heating. The company's representatives were William H.Wells, president; Charles R. Bishop, secretary; H. C. Kimbrough, Western manager; W. J. Kline, sales engineer; R. C. Holly, manager of the Atmospheric department; Lloyd Howell, of the Chicago office and C. S. Williams, of the home office.

A. M. Byers Co., Pittsburgh, Pa., had an interesting exhibit consisting of samples of Byers genuine wrought-iron pipe, taken from the heating system in the Eden Musée, New York, after 33 years' service; also a piece of 6-in. pipe taken from Wood Street, Pittsburgh, after 28 years' service, and many other samples, including various sizes of pipe manufactured by the company, both black and galvanized. E. B. Pierce and Fletcher Collins, took care of the company's interests.

Illinois Engineering Co., Chicago, Ill., showed a radiator equipped with an Illinois modulating supply valve and radiator thermostatic trap. There were also on display an Eclipse pressure-reducing valve especially designed for vacuum heating work, and an Eclipse combination back pressure and relief valve; also an Eclipse low pressure dash-pot reducing valve. J. C. Matchett, secretary, and H. H. Hughson, Michigan representative, were in charge.

National Air Cell Covering Co., Jersey City, N. J., also had a durability exhibit. At one end of the table was a section of double standard-thickness Pyrobestos insulation that had been in the ground 8 years. To all appearances it was similar in appearance to an adjoining length of new Pyrobestos insulation, having in no way deteriorated. The company also showed a section of Pyrobestos that had been in water for four years without showing any ill effects. C. C. Hall, of the home office, was on hand for the company.

Tyler Underground Heating Systems, Pittsburgh, Pa., had a booth but no display. E. B. Tyler, president of the company, and Fred G. Otto, engineer and salesman, were present.

National Tube Co., Pittsburgh, Pa., had on exhibition samples of tests made on National boiler tubes. The exhibit also included a unique pyramid of National pipe, including sizes from ¼-in. to 30 in. in diameter. Samples of Kewanee specialties were shown, including Kewanee unions and Kewanee regrinding valves. The company's representatives in attendance were H. R. Redington, H. W. Collins, L. F. Hamilton, A. M. Lally, A. F. Taylor and C. E. Kennish.

J. C. Hornung, Chicago, Ill., showed types of his steam or water pressure control valves, temperature control for either steam or hot water, combined pressure and temperature control valve; also four types of thermostats, air, water and electric, and electric with clock for automatically turning the temperature back during the night hours; tank regulators for controlling domestic hot water tanks, the Hornung magnetic pilot valve for re-establishing temperature control when air lines have failed, and Debonite central station pipe covering for underground mains. J. C. Hornung had charge of the exhibit.

Armstrong Cork & Insulation Co., Pittsburgh, Pa., displayed models showing the setting and drums of a water-tube boiler insulated with Nonpareil insulating brick, and an underground line covered with Nonpareil high-pressure covering. There were also shown Nonpareil high-pressure block and cements, Nonpareil corkboard for cold storage insulation and Nonpareil cork covering for brine and ice water lines. A. B. Alexander and C. E. Schoeneman represented the company.

General Electric Co., Schenectady, N. Y., had an exhibit containing full size models of its flow meter in three types, with the accessories. There was also a stereomotorgraph in the company's booth, showing typical flow-meter installations. The company's factory representative was R. E. Woolley and its Detroit representative, A. E. Ingersoll.

V. D. Anderson Co., Cleveland, O., showed samples of its Model D steam trap, Junior steam trap and air trap; also the Anderson line of steam and oil separators. Joseph H. Meyer, the company's Detroit representative, was in charge.

W. H. Pearce & Co., Chicago, Ill., exhibited a new device, consisting of a Crescent heat controller, for controlling the heat in a number of buildings from the power house. The company also had types of the Crescent steam meters and the Crescent conduit construction. The company was represented by W. H. Pearce, W. H. Pearce, Jr., of Chicago, and H. J. Clemons, of the Detroit office.

Bailey Meter Co., Boston, Mass., showed one of the Bailey fluid meters, Type C2 and Ervin G. Bailey, president of the company, was on hand to explain its construction and operation.

Ric-Wil Co., Cleveland, O., exhibited a model of its underground insulated conduit for heating mains, showing the construction used for both single and multiple pipe lines. This model was uniquely arranged before a large mirror so that both sides of the conduit could be seen from the front. The company was represented by F. H. Stevens, Chicago manager.

Fremont Mfg. Co., Fremont, Mich., had a popular exhibit showing the operation of a Bacon portable pipe-cutting and pipe-threading machine. This machine is a self-contained unit and was operated by a small gasoline motor. It cut and threaded various sizes of pipe up to 6-in. Louis Webber, general manager of the company, and A. F. Bacon, the inventor of the apparatus, were present, Mr. Bacon personally operating the machine.

L. S. Shaw & Co., Detroit, Mich., exhibited the Detrick flat suspended arch for steam boilers and furnaces, also a working model of the Connelly boiler, made by D. Connelly Boiler Co., Cleveland, O. L. S. Shaw, president, and F. A. Green, had charge of the exhibit and distributed matter on Terry turbines, Vater water softeners and the General Concrete Construction Company's chimneys.

Republic Flow Meter Co., Chicago, Ill., had its Type F and Type C steam flow meters in operation. There was also a section of a meter showing its construction. The company exhibited a new Pitot tube which was featured as being non-plugging; and a new resistance element, the contact rods of which are graduated to the square root function. There was also a Republic recording hydrometer on exhibition. J. D. Cunningham, president, and C. E. McGregor, were in charge.

H. W. Johns-Manville Co., New York, showed different sizes of the J-M steam trap, J-M underground conduit installation (full-size model) indicating the method of supporting pipe and providing for underdrainage. The company's representatives were H. McKinley, manager of the power specialty department for Michigan and Ohio; J. B. Webb, Detroit representative, and L. B. McMillan, engineer for the general power specialties department.

Those Present:

ACTIVE MEMBERS.

Byron T. Gifford, Grand Rapids, Mich.
D. L. Gaskill, Greenville, Ohio.
Geo. W. Martin, New York Service Co., New York.
A. E. Blosser, Lockport Lt. Ht. & Pr. Co., Lockport, N. Y.
E. R. Little, Little & Shepard, Detroit, Mich.
W. H. Ballard, W. H. Ballard & Co., Boston, Mass.
O. F. Rabbe, Toledo Railways & Light Co., Toledo, O.
A. C. Rogers, Toledo Railways & Light Co., Toledo, O.
Geo. J. Kerth, Overbrook Steam Heating Co., Philadelphia, Pa.
Elmer B. Plapp, Allegheny Co. Steam Heating Co., Pittsburgh, Pa.
James Lynch, Home Heating Co., Erie, Pa.
W. G. Carlton, Grand Central Terminal, New York.
H. A. Austin, New York Steam Co., New York.
H. J. Klotz, Decatur Railway & Light Co., Decatur, Ill.
L. R. Crawford, Sioux City Service Co., Sioux City, Ia.
E. L. Kirk, Sioux City Service Co., Sioux City, Ia.
Robt. Ilett, Valentine Heating Co., Toledo, O.
O. M. Rau, Commonwealth Power Co., Milwaukee, Wis.
Vernon M. F. Tallman, Worcester Elec. Light Co., Wor ester, Mass.
C. J. Cooper, Jr., Merchants Heating and Lighting Co., Indianapolis, Ind.

C. H. Spiehler, Dayton Power & Light Co., Dayton, O.
Thos. F. Kelly, Dayton Power & Light Co., Dayton, O.
F. R. Brosius, Union Gas & Elec. Co., Cincinnati, O.
A. B. Grubmeyer, Cons. Gas Elec. Light & Power Co., Baltimore, Md.
John R. Allen, University of Michigan, Ann Arbor, Mich.
J. D. Hoffman, University of Nebraska, Lincoln, Nebr.
Geo. H. Alexander, Frankfort Heating Co., Frankfort, Ind.
Jno. Devine, Miami University, Oxford, O.
Dudley J. Hard, Cleveland Light & Power Co., Cleveland, O.
J. W. Pyle, Peru Heating Co., Peru, Ind.
C. H. Henze, Hiram Walker & Sons, Walkerville, Ont.
A. H. Lamond, Michigan Power Co., Lansing, Mich.
A. W. Higgins, Mineral Point Public Service Co., Mineral Point, Wis.
D. A. Brown, Shorthand Reporter, Cincinnati, O.
J. C. Hobbs, Duquesne Light Co., Pittsburgh, Pa.
F. S. Karn, Duquesne Light Co., Pittsburgh, Pa.
J. G. Hauser, U. & C. Railway Gas & Electric Co., Champaign, Ill.
C. F. Snyder, B. N. Railway & Light Co., Bloomington, Ill.
Geo. L. Flechsenhaar, Illinois Traction System, Champaign, Ill.
W. J. Fitzgerald, Detroit-Edison Co., Detroit, Mich.
H. F. Winte, Detroit-Edison Co., Detroit, Mich.
Arthur S. Allbright, Detroit-Edison Co., Detroit, Mich.
Chas. C. Munroe, Detroit-Edison Co., Detroit, Mich.
Russell W. Symes, Detroit-Edison Co., Detroit, Mich.
A. D. Spencer, Detroit-Edison Co., Detroit, Mich.
J. B. Kellogg, Detroit-Edison Co., Detroit, Mich.
James Trombley, Detroit-Edison Co., Detroit, Mich.
J. H. Walker, Detroit-Edison Co., Detroit, Mich.
A. VanVlict, Detroit-Edison Co., Detroit, Mich.
Norman W. Calvert, Detroit-Edison Co., Detroit, Mich.
Arthur J. Duke, Detroit-Edison Co., Detroit, Mich.
Chas. C. McAllister, Vandergrift Steam Heating Co., Vandergrift, Pa.
J. F. Horn, Vandergrift Steam Heating Co., Vandergrift, Pa.
Andrew Pinkerton, Vandergrift Steam Heating Co., Vandergrift, Pa.
Sam B. Mott, Noblesville Heat, Light & Power Co., Noblesville, Ind.
D. D. McEachin, City Municipal Plant, Hibbing, Minn.
Master D. D. McEachin, Hibbing, Minn.
D. D. Haley, City Municipal Plant, Hibbing, Minn.
J. D. Rooney, Hibbing, Minn.
Ira N. Evans, Johnson, Larsen & Co., Detroit.
J. F. Lewis, U. S. N.
C. A. Hamilton, Consumers Power Co., Saginaw, Mich.
Henry Meyer, Citizens Mutual Htg. Co., Terre Haute, Ind.
Geo. D. Higgins, 60 Penobscot Bldg., Detroit, Mich.
Geo. J. Soucy, Consumers Heating Co., Kitchener, Ont.
J. N. Moncrieff, Wis-Minn Light & Power Co., LaCrosse, Wis.

ASSOCIATE MEMBERS.

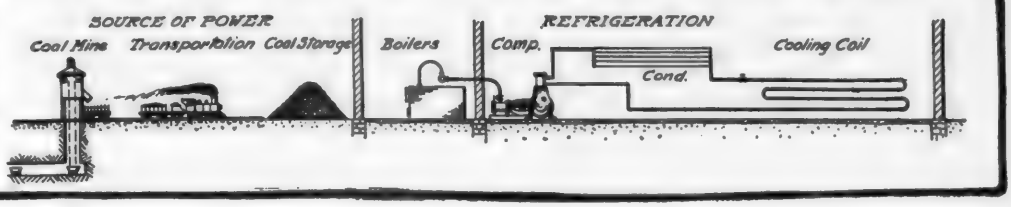
C. Seymour Williams, American District Steam Co., N. Tonawanda, N. Y.
Lloyd Howell, American District Steam Co., Chicago.
R. C. Holley, American District Steam Co., N. Tonawanda, N. Y.
Walter J. Kline, American District Steam Co., N. Tonawanda, N. Y.
Charles R. Bishop, American District Steam Co.
William H. Wells, American District Steam Co., N. Tonawanda, N. Y.
A. G. Crocker, Westinghouse Electric & Mfg. Co., Detroit, Mich.
Jas. C. Matchett, Illinois Engineering Co., Chicago.
R. B. Osgood, Jenkins Bros., Chicago.
E. G. Bailey, Bailey Meter Co., Boston.
R. E. Woolley, Gen. Elec. Co.. Schenectady.
F. H. Stevens, The Ric Wil Co., Chicago.
Frank A. Green, L. S. Shaw Co., Detroit.
L. S. Shaw, L. S. Shaw Co., Detroit.
Martin A. Rooney, American Radiator Co., Detroit.
Thomas Wilson, *Power*, Chicago.
E. L. Downs, U. S. Radiator Corporation, Detroit.
J. S. Crane, Detroit Lubricator Co., Detroit.
Fletcher Collins, A. M. Byers Co., Pittsburgh.
E. B. Bierce, A. M. Byers Co., Pittsburgh.
F. F. Vater, Power Plant Specialty Co., Chicago.
Charles H. Bishop, *Metal Worker*, Chicago.
Jas. D. Cunningham, Republic Flow Meters Co., Chicago.
A. Cameron, General Electric Co., Detroit.
A. E. Ingersoll, General Electric Co., Detroit.
Jos. H. Meyer, V. B. Anderson Co., Cleveland.
H. W. Collins, National Tube Co., Pittsburgh.
H. R. Redington, National Tube Co., Pittsburgh.
L. F. Hamilton, National Tube Co., Pittsburgh.
G. C. Hall, National Air Cell Covering Co., Jersey City, N. J.
W. H. Pearce, W. H. Pearce Co., Chicago.
W. H. Pearce, Jr., W. H. Pearce Co., Chicago.
A. S. Armagnac, THE HEATING AND VENTILATING MAGAZINE, New York.
H. C. VanSickle, Wright Mfg. Co., Detroit, Mich.
R. A. Foreman, Westinghouse Electric & Mfg. Co., Chicago.
A. F. Bacon, Fremont Mfg. Co., Fremont, Mich.
Louis Webber, Fremont Mfg. Co., Fremont, Mich.
Arthur Metzger, Alberger Pump & Condenser Co., Chicago.
H. McKinley, H. W. Johns-Manville Co., New York.
L. B. McMillan, H. W. Johns-Manville Co., New York.
J. B. Webb, H. W. Johns-Manville Co.
Gordon D. Cooke, McGraw-Hill Publishing Co.
E. B. Tyler, Tyler Underground Heating Systems, Pittsburgh.
Ford G. Otte, Tyler Underground Heating Systems, Pittsburgh.
Claude Bowlus, American School of Correspondence, Scranton, Pa.
J. C. Hornung, 343 No. Dearborn St., Chicago.
Geo. D. B. VanTassel, Power Specialty Co., Chicago.
F. W. Sleep, Chapman Valve Mfg. Co., New York.
Thos. T. Maher, Chapman Valve Mfg. Co., New York.
C. B. Veal, Central Station Steam Co., LaFayette, Ind.
Geo. C. King, Central Station Steam Co., LaFayette, Ind.
W. R. Owen, Central Station Steam Co., Detroit.
W. G. Bryant, Central Station Steam Co., Detroit.
J. V. Redfield, Central Station Steam Co., Detroit.
H. H. Hughson, 160 Tuxedo Ave., Detroit.
H. C. Kimbrough, American District Steam Co., Chicago.
F. T. Schieiner, Jr., McAlear Mfg. Co., Detroit.
Paul Jones, Precision Instrument Co., Detroit.
E. P. Fitzgerald, Roe Stephens Mfg. Co., Detroit.
C. E. McGregor, Republic Flow Meters Co., Chicago.

Health Perils of Munition Workers.

Some of the dangers that munition workers are exposed to and how they can be avoided is told by Dr. W. A. Evans in the *Chicago Tribune*. From all parts of the world, he states, where high explosives are manufactured, there come reports of serious and sometimes fatal poisonings due to the fumes and dust. The workers in the Dupont factories, however have largely escaped such injuries and among the precautions taken by this company are the following:

In the acid rooms the men suffer from acids splashing and acid fumes. All munition factory rooms are thoroughly ventilated. The air is removed by exhaust fans through multiple outlets in the floors, and fresh air enters through multiple inlets located in the ceiling. Near every acid vat there are water nozzles, tubs or showers. When a man gets a splash he turns on the water or jumps into a tub at once. Next he applies saturated solution of bicarbonate of soda until the foaming stops. Next he applies a burn ointment.

AIR COOLING AND REFRIGERATION



Refrigeration by the Absorption System

Refrigeration by means of the compression system having been previously discussed in these columns it is assumed that the reader is thoroughly familiar with the theory and principles involved in this method of cooling, and it is now desired to take up refrigeration as carried on in what is commonly termed the "absorption" system. In this system no compressor is necessary, its place being taken by the generation of pressure produced in evaporating ammonia by means of heat largely in the manner employed in the common steam boiler, excepting that the temperature is not quite as high.

THEORY OF ABSORPTION SYSTEM.

The theory is more easily grasped by reference to Fig. 1 which shows diagrammatically the primary process of refrigeration by absorption. In this figure A represents a closed cylinder connected by a pipe P to another closed cylinder B. The second cylinder sets in a tank T-2 which is filled with water W from the water pipe WP, while the first cylinder sets in a tank T-1 and can be sprayed from time to time by the sprays S from the cold water line CW. The water from the sprays flows off through the drain D and heat can be applied to the cylinder when desired by means of the flame F. The tank T-2 may be emptied by opening the drain valve DV.

OPERATION OF APPARATUS.

To operate the apparatus, A is filled with a quantity of highly charged aqua ammonia, which is water containing ammonia and must be clearly distinguished from anhydrous ammonia which is commercially pure ammonia without water. Heat is then applied to A, (the sprays not being in operation) and as A becomes heated the ammonia begins to vaporize, the air above the ammonia being allowed to pass out through the relief cock R. As soon as the air is expelled the cock is shut and the evaporating ammonia then builds up the pressure in A, P and B until the low temperature produced in B by the cooling water W combined with the excessive pressure generated by A owing to the flame F results in liquefying the gas in cylinder B; this corresponding exactly to the high pressure produced by the compressor in the compression system and the cooling and condensing of the gas in the condenser. The pressure produced in this apparatus is about

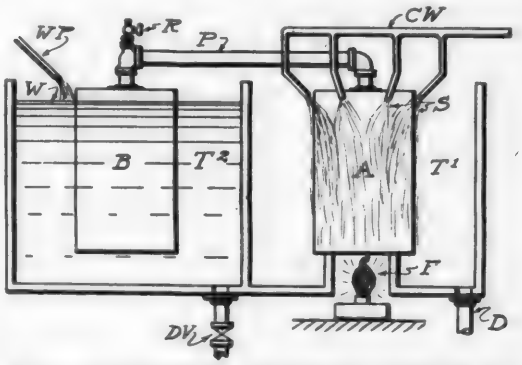


FIG 1.—DIAGRAM ILLUSTRATING THEORY OF ABSORPTION SYSTEM OF REFRIGERATION.

120 lbs. per square inch which raises the boiling point of the water retained in A to about 230° F., thus preventing the vaporization of the water at the time the ammonia is liberated at the increased temperature.

After an interval of time the water in tank T-2 is drawn off and replaced with whatever substance it is desired to refrigerate. The water spray S is then turned on tank A and the flame F removed. The cooling of A by water spray cools and condenses the gases contained therein and relieves the pressure on the whole system at which time the liquid anhydrous ammonia which has collected in tank B begins to vaporize owing to removal of the pressure and in so doing takes up the heat from the surrounding liquid or substance

to be cooled, thus producing the refrigerating effect. This, in brief, is the principle of the absorption system, as the gas after evaporization passes back into tank A and is absorbed by the water therein.

PRACTICAL APPLICATION OF ABSORPTION SYSTEM.

In the practical operating plant conditions are more involved and the careful study of its parts must be made. Fig. 2 shows a diagrammatical elevation of a practical plant the cycle of the process being as follows: The aqua ammonia is placed in still S which corresponds to the original chamber A in Fig. 1, while to produce heat in the still a spiral steam coil is installed. The ammonia gas is driven from the still (by the heat of the steam coil) and passes up the vapor pipe V to the dehydrating coil DH which is enclosed in a tank filled with water at about 150° F. At this temperature whatever water may be contained in the vapor condenses but the ammonia still remains a gas. After passing through the dehydrating coil the condensed water and ammonia gas pass down into a separating tank ST. From the bottom of the separating tank the raw water or condensation returns to the still through the pipe RW while the pure ammonia gas passes

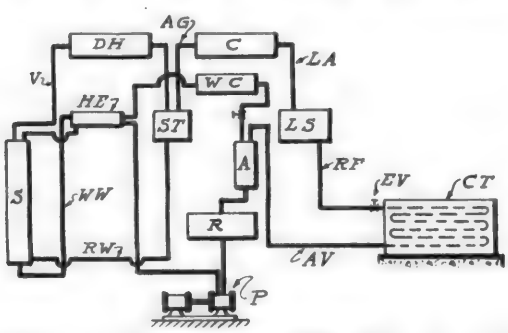


FIG. 2.—TYPICAL ARRANGEMENT OF ABSORPTION SYSTEM.

through the ammonia gas pipe AG to the condenser D which consists of a group of coils, either water or air cooled. In this part of the system the ammonia is cooled and under its pressure condenses in a manner similar to the action in a compression system.

It must be remembered that the vaporizing of the ammonia in the still S produces a pressure of about 150 lbs. which is maintained all through the system up to the condenser.

REFRIGERATING PROCESS.

The ammonia is now ready for use having been liquefied, cooled and compressed to a pressure of 150 lbs. per square inch. From the condenser C it flows through the liquid ammonia pipe LA to the liquid storage tank LS and then through the refrigeration pipe RF to the expansion valve EV which allows the ammonia to expand and refrigerate in the coil contained in the cooling tank CT, in which coil a pressure of about 15 lbs. is maintained. From the cooling tank the expanded ammonia gas goes through the ammonia vapor pipe AV to the absorber A in which it enters at the top and meets a flow of water so as to thoroughly intermingle and be absorbed by the water.

To understand where this water comes from it is necessary to go back to the ammonia still S and remember that the water which has been freed from the gas is retained in this still. This is termed "weak water" and after expelling the gas it is allowed to flow from the still through the weak water connections WW to the heat exchanger HE. Here it is cooled and then passes on to the weak water cooler WC, where it is further cooled by cold water, and from this point it is allowed to flow into an absorber A and furnishes the water supply to absorb the returning gas from the cooling tank. After this absorption has taken place aqua ammonia results which flows into the reservoir R. The pump P then draws the cool aqua ammonia from the reservoir and discharges it through the heat exchange tank HE back into the still S. Thus the heat of the weak water flowing to the absorber is transferred to the aqua ammonia coming back from the absorber to the still and it therefore requires less heat in the still S to re-vaporize the ammonia so as to repeat the cycle.

NOTES

The United Cork Companies, Lyndhurst, N. J., have issued an interesting new catalogue of 152 pages and 97 illustrations for the use of those interested in insulation work. This catalogue gives much information regarding the advantages of cork for refrigeration work.

The De La Vergne Machine Co., New York, has issued two new bulletins, No. 61 which compares the horizontal and vertical types of ammonia compressors, and No. 60 on ammonia purifiers.

Heating Standards Adopted by the Chicago Master Steam Fitters' Association

The need of standard practice for heating installations in such buildings as apartments and residences has led the Chicago Master Steam Fitters' Association to adopt standards for computing boiler sizes and radiation quantities for buildings of average construction and for sizing low pressure steam mains, risers, branches, radiator connections, etc., on a one-pipe circuit system, dripped at end.

The main trouble with the ordinary installation in an apartment house and in many residences is that very few of such buildings can be heated to 70° F. when it is 10° below zero outside, and the rules for computing radiator quantities are designed to take care of that condition.

Radiation Rules.

Following is the schedule for computing minimum quantities of steam radiation at 70° F. with outside temperature at—10° F.:

One sq. ft. of radiation for every 300 cu. ft. of contents, plus 1 sq. ft. of radiation for every 15 sq. ft. net exposed wall surface, plus 1 sq. ft. of radiation for every 2 sq. ft. of glass surface.

For all rooms with plastered ceilings and unheated air space between ceiling and roof, add 1 sq. ft. of radiation to every 30 sq. ft. of ceiling area.

For all rooms with ceiling plastered on roof joist, add 1 sq. ft. of radiation to every 20 sq. ft. of ceiling area.

For all rooms with ceiling of open joist or concrete roof construction, add 1 sq. ft. of radiation to each 10 sq. ft. of roof.

For all rooms with northeast or northwest exposures add 10% additional radiation.

Where radiators are placed under seats or behind grills, add 20% additional radiation.

Where radiators are placed in open recesses, add 10% additional radiation.

For indirect radiation, add 50% additional.

For direct-indirect without fan system, add 25% additional radiation.

In measuring glass surface the full opening in wall shall be figured. Outside door openings shall be taken as glass.

For computing minimum quantities of hot water radiation at 70° F. with outside temperature at minus 10° F., add 60% to amount necessary for steam.

For computing minimum quantities for vapor systems at 70° F. with outside temperature at minus 10° F., add 20% to amount necessary for steam.

VAPOR SYSTEMS.

A vapor system is defined as a two-pipe steam system which has the return lines open to atmosphere with no valve at the return connections of heating units which will close against steam.

For heating to temperatures other than minus 10° F. to 70° F. multiply above quantities by the following co-efficients:

—10° to 65°	0.94
—10° to 60°	0.87
—10° to 55°	0.81
—10° to 50°	0.75
—10° to 45°	0.69
—10° to 40°	0.62

HOT BLAST COILS.

For computing boiler sizes to be used for hot blast coils, use manufacturers' condensation charts and figure ¼ lb. of condensation per hour as equivalent to 1 sq. ft. of direct radiation.

The above schedules of quantities are commensurate with good heating results for the average building of average construction, but by no means to be construed as guarantees of the proper quantities of radiation necessary to heat every building, as extraordinary conditions will of course require additional radiation.

RULE FOR COMPUTING BOILER SIZES.

Schedule for computing minimum sizes of boilers for the average building based on ratings specified in the manufacturer's catalogue issued previous to March, 1916.

Cast Iron Up-Draft Boilers—Size of boiler should be 80% greater than the actual amount of radiation in radiators and coils. See †.

Cast Iron Down-Draft Boilers—Size of boiler should be 60% greater than the actual amount of radiation in radiators and coils. See †.

Steel Firebox, Brick Set, Up-Draft Boilers—Size of boiler should be 35% greater than the actual amount of radiation in radiators and coils. See †.

Steel Firebox Brick Set, Up Draft with approved Furnace—To be figured on same basis as steel down draft of similar number.

Steel Firebox, Brick Set or Portable, Down-

Draft Boilers—Size of boiler should be 40% greater than the actual amount of radiation in radiators and coils. See †.

Cast Iron Magazine Type—Size of boiler shall be 60% greater than the actual amount of radiation in radiators and coils.

Steam Main Sizes.

The sizes of low pressure steam mains, one-pipe circuit system, dripped at end, as recommended by the association, are as follows:

Amount of Radiation, Sq. Ft.	Size Main Required, In. Diam.
Up to 60	1
60–100	1 ¼
100–200	1 ½
200–400	2
400–600	2 ½
600–900	3
900–1400	3 ½
1400–2000	4
2000–2600	4 ½
2600–3300	5
3300–4500	6
4500–7000	7
7000–9000	8
9000–11000	9
11000–15000	10
15000–24000	12

On all piping, proper provisions shall be made for expansion and contraction.

All piping shall be properly pitched.

All horizontal branches more than 12 ft. in length shall be increased 2 sizes.

All horizontal branches more than 16 ft. in length shall be properly dripped.

Supply mains shall not be reduced more than one-half the diameter of the largest main.

Dry returns shall be not less than one-half the diameter of the supply.

Wet returns may be one size smaller than one-half the diameter of the supply pipe. By supply pipe is meant the size of main at the point of leaving boiler.

† Where coils are to be inserted in boiler for heating water for domestic purposes, size of boiler should be increased, figuring each gallon of water tank capacity as equivalent to 2 sq. ft. of radiation. For example, a 160-gal. tank should be figured as equivalent to 320 sq. ft. of radiation. If this is connected to an up-draft cast-iron boiler, the increased size of the boiler would be 320 plus 80% or 576 sq. ft. If connected to a firebox up-draft boiler, increased size of boiler should be 320 plus 35% or 432 sq. ft.

Up-Feed Risers and Radiator Connections.

The following pipe sizes are recommended for up-feed risers:

Amount of Radiation, Sq. Ft.	Size Riser Required, In. Diam.
Up to 25	1
25–60	1 ¼
60–100	1 ½
100–200	2
200–350	2 ½
350–900	3
900–1200	3 ½
1200–2000	4
RADIATOR CONNECTIONS.	
Up to 25	1
25–60	1 ¼
60–90	1 ½
Above 90	2

All horizontal connections to radiators shall be increased one size, except branches for radiators from 91 to 130 sq. ft., which may be the same size as radiator connections.

All horizontal connections to risers shall be increased one size.

The Difference Between an Engine Horse Power and a Boiler Horse Power.

There is a decided difference between an ordinary horse power and a boiler horse power. A boiler horse power is more than 13 times as great as an engine horse power The definition of a boiler horse power is given as "the amount of heat required to evaporate 34.5 lbs. of water from and at 212° F. per hour." It has been figured that this amount of heat is equal to 33,479 B.T.U. per hour.

An ordinary engine horse power is equal to 33,000 foot-pounds per minute. Since it takes 778 foot-pounds to make 1 B.T.U., one can easily figure that an ordinary horse power is equal to 2,546 B.T.U. per hour.

We are now ready to find the relation by dividing as follows: 33,479 ÷ 2,546 = 13.149. Roughly speaking, therefore, the engine horse power is only one-thirteenth as great as the boiler horse power.—*W. F. Schaphorst.*

A recent instance of the appointment of an engineer to a town school board is reported from Gary, Ind., where A. R. McArthur, an engineer of that place, has recently received such an appointment. The Gary schools have a reputation as the originators of the "model school system."

LEGAL DECISIONS

Competing Companies.

The fact that a light, heat, and power company has secured the consent of borough authorities to the use of the borough streets does not, the Pennsylvania Superior Court holds, Relief Electric Light, Heat & Power Co.'s Petition, 63 Pa. Sup. Ct., 1, relieve it from the necessity of securing a certificate of public convenience from the Public Service Commission; and if such certificate is denied it cannot complain that it has been deprived of its property without due process of law, or that the order of the Commission is an impairment of the obligation of a contract. In supplying the service the petitioning company would compete with the West Penn Lighting Company, a Pennsylvania corporation, which had served the borough for a number of years and which intervened. It appeared that this company was serving the borough satisfactorily and at reasonable rates, and, therefore, an order of the Commission refusing the petitioner a certificate of convenience to occupy the streets was sustained although the borough authorities had consented to such use of the streets.

Suits on Contracts.

A manufacturer of ranges and stoves sold to its agent goods which he subsequently sold to a building contractor. The latter entered into a contract with an owner to complete the building in process of construction free from mechanics' liens and save the contractor harmless from all liens and material. In an action by the manufacturer the Illinois Appellate Court held that the contract was for the benefit of the manufacturer and entitled him to sue and recover thereunder. Whitcomb vs. Seney, 199 Ill. App., 526.

Review of Assessments by Courts.

When a public service corporation, or other taxpayer goes before a board of equalization to protest against an alleged excessive assessment made by the assessor, the burden is held to be on it to point out in what particulars the assessor made an excessive assessment, and it must give to the board full and truthful information touching all matters that will enable it to arrive at a correct valuation of the property, and show by convincing evidence that the assessment made by the assessor was excessive, and why and in what respects. On the other hand, the board should also on request furnish to the taxpayer the facts and figures on which it proposes to estimate the value of the franchise and information as to the method by which it arrived at its conclusion, so that the taxpayer may be prepared to challenge the facts and figures as well as the conclusion reached by the board. The state and cities are only entitled to a just and fair assessment according to constitutional standards and limitations, and to get at this result the board is entitled to full and truthful information from the taxpayer, and the taxpayer has the right to have the board furnish him with the facts, figures, and methods by which it estimates the value of the franchises involved. Kentucky Heating Co. vs. Louisville, Kentucky Court of Appeals, 192 S. W., 4.

Difference Between Initial and Normal Heating of a Radiator.

By H. S.

It is surprising how great the difference is in the amount of steam necessary to heat up a radiator and the amount necessary to keep it warm, after it is once heated. The average radiator, of the steam type, weighs about 6½ lbs. per square foot. A 100-sq. ft. radiator would therefore weigh 650 lbs. Assume the room in which the radiator is located to be at a temperature of 50° F., which is about the usual temperature. The temperature of the steam, assuming the pressure to be 2 lbs., would be 220° F. Thus the difference in temperature between the steam and the room is 170°.

The specific heat of cast-iron is 0.13. Therefore, $650 \times 170 \times 0.13 = 14{,}365$ B.T.U., which is the total amount of heat necessary for the initial heating of the radiator. Dividing 14,365 B.T.U. by 961, the latent heat of steam at 2 lbs. pressure, the result is 14.94, the pounds of steam required for the initial heating of the radiator. An ordinary steam radiator, with the proper size steam connection, will heat up in 15 min. as a maximum length of time.

After the radiator is heated it will require 14-lb. per square foot per hour for the normal heating, provided the room is kept at a temperature of 70° F. Therefore,

a 100-sq. ft. radiator will require 25 lbs. of steam per hour for the normal heating. For a period of 15 minutes this radiator will require 6¼ lbs. of steam for the normal heating.

It can readily be seen that about 2½ times as much steam is required for the initial heating than is required for the normal heating of the radiator during the same period of time. If the temperature of the room to be heated is lower than 50°, the amount of steam for initial heating will be larger in proportion.

CORRESPONDENCE

Basis for Figuring Condensation in Steam Heating Systems Per Year.

EDITOR HEATING AND VENTILATING MAGAZINE:

Will you kindly advise us what you estimate the number of pounds of condensation is per year in steam heating systems? Also does this include the condensation in the service lines in the streets and, if not, what percentage do you allow for line loss?

Greenville, Pa. C.

The amount of steam used per square foot of radiation per year is an extremely variable quantity depending upon the season, the use of a meter, and the building in which the service is rendered. Where heating installations have been metered it has been found to be in the neighborhood of 500 lbs. per annum, but where unmetered service is installed it is quite likely to run much higher. In fact, in the locality of New York it is usual to allow 100 lbs. of coal per annum, which at 8,000 B. T. U. per pound of coal, is equal to 800,000 B. T. U. supplied inside of the building; and, at approximately 1,000 B. T. U. per pound of condensation, this would represent about 800 lbs. per square foot per season. Another district heating company allows ⅓ lb. per square foot per hour for the connected load as a maximum service and since each square foot of radiator surface condenses about ¼ lb., this leaves a balance of 0.08 ⅓ lbs. per square foot for line loss, although part of this takes place inside of the building.

Figuring Heater Sizes for Hot Water House Service.

EDITOR HEATING AND VENTILATING MAGAZINE:

We are installing a heating plant in a small building where our boiler capacity must be kept down owing to lack of space in the boiler room. The job also includes hot water equipment to "raise 500 gal. of water from 50° to 150° F. per hour," the water being heated by steam. We have found out that the water will probably all be used for washing up in a period of about 15 minutes with 4 hours interval between times of using.

Can you recommend a rule by which the capacities of various cast-iron heating boilers rated in different ways may be reduced to a comparable and reasonably exact basis and also suggests whether a hot water storage heater or a steam heater of instantaneous type —which would be much cheaper for us— would allow us to use a boiler of smaller capacity and help us out in the matter of space in the boiler room. R. L.

Our correspondent can fulfill the letter of his contract by supplying hot water at the rate of $500 \div 60 = 8\frac{1}{3}$ gal. per minute, the heating of which would require roughly 8⅓ lbs. of steam per minute regardless of whether an instantaneous or storage type of heater be used. Every gallon of water raised 100° F. requires approximately 1 lb. of steam at 5 lbs. pressure which is shown by the following:

1 gal. = 8⅓ lbs. of water.

8⅓ lbs. @ 100° rise = 833 B. T. U.

Radiation and pipe losses, 20%.

833 + 20% of 833 = 833 + 166 = 999 B. T. U.

1 lb. of steam at 5 lbs. = latent heat of 961 B. T. U.

Owing to the conditions requiring the use of 500 gal. in 15 minutes we would advise the use of the storage heater *to give satisfaction* and not because of any requirement in the contract. An instantaneous heater to supply 500 gal. in 15 minutes would take a heater rated at $500 \times \frac{60}{15}$ or 2000 gal. per hour, which also means steam at the rate of 2000 lbs. per hour or $2000 \times 4 = 8000$ sq. ft. increase in boiler rating for hot water alone.

On the other hand, with a storage heater and four hours between periods of use it would be entirely practical to put in a heater with a heating capacity of $500 \div 4$ or 125 gal. per hour or 125 lbs. of steam, resulting in an increase of boiler rating for hot water of only $125 \times 4 = 500$ sq. ft.

The storage capacity of the storage heater should be made one-third more than the

amount used at the end of each period or

500 + ⅓ of 500 =

500 + 167 = 667 gal.

Therefore a 700-gal. storage heater with a heating capacity of 125 gal. per hour would produce the smallest load on the steam boiler and an instantaneous steam heater would produce the greatest load. As far as cost goes, the reduction in the size of the steam boiler and the size of steam pipe and valves for the storage heater will more than counterbalance the additional cost of the storage heater.

In regard to checking the sizes of cast-iron steam boilers, it has always been found that the grate area has a great deal to do with the amount of steam produced. It is easily possible to get double the rating out of the same boiler when the grate area is doubled or when the draft is increased so as to burn double the quantity of coal.

Even with natural draft and frequent attention we do not believe it is wise to exceed a combustion rate of 10 lbs. of coal per square foot per hour which at 8000 B. T. U. turned into steam gives a rating of 8000 × 10 ÷ 250 = 320 sq. ft. per square foot of grate surface. This method will give a pretty good check on any cast-iron heating boiler although for residence work not over 6 or 7 lbs. of coal per square foot of grate per hour should be figured.

A Correction.

In the article in THE HEATING AND VENTILATING MAGAZINE for May, 1917, on "Recent Progress in the Use of Gas for House Heating," it was mentioned that the compilation of the data presented in the article had been made by a committee on auxiliary heating appointed by the American Gas Institute. It should be stated that this compilation was made by the committee on auxiliary heating of the National Commercial Gas Association.

In a letter calling attention to this error, George A. Barrows, chairman of that committee states: "There is a committee of the American Gas Institute on house heating, of which Mr. C. C. Winterstein, of the United Gas Improvement Company, of Philadelphia, is chairman. These two committees are co-operating, the committee of the American Gas Institute studying particularly the engineering questions while the committee of the National Commercial Gas Association is paying particular attention to the commercial questions."

In this connection attention is called to the article on "Manufactured Gas for House Heating," by George S. Barrows and C. C. Winterstein, in the March, 1917, issue.

A Residence Without a Chimney.

A building without a chimney and supplied by one company with steam for heating, electricity for light and power, gas for cooking and water for domestic purposes is shown in the accompanying illustration. It is located in Excelsior Springs, Mo., being known as the Ligon Apartments. The building has a full cement basement which has storage lockers belonging to each apartment. It is constructed of red cherry-colored brick, trimmed with stone trimmings and is divided into twelve apartments, each having large closets and private baths. The apartments are furnished with the latest improved combination furniture, all beds being of the disappearing type, leaving a maximum amount of room space during the day time.

The steam for heating is furnished through underground mains and this, as well as the other services mentioned, are supplied by the Excelsior Springs Water, Gas and Electric Company. The building is piped for the American District Steam Company's Atmospheric system.

In place of the chimney there are small openings in the wall about 4 in. square, for taking away the fumes from the gas stoves. No provision is made at all for any other fire.

LIGON APARTMENTS, EXCELSIOR SPRINGS, MO., BUILT WITHOUT A CHIMNEY

When the building was being constructed the owner was advised to put in a flue for emergency purposes. His reply was that he was satisfied something would happen to his building before it did to the company's plant. It was figured that he saved from 10% to 12% on insurance by leaving out all suggestions of furnace or fire-places.

A 500-gal. tank, fitted with steam coils for furnishing hot water to the building is located in the basement. The heating system and the hot water tank are on separate valves so that either may be operated at any time independently of the other. It should be mentioned that the company

keeps steam on its mains the year round and has thereby connected a fairly good-sized load during the summer months for heating water in the hotels, bath houses, apartment houses and barber shops.

The Excelsior Springs Water, Gas & Electric plant was first put in operation in 1912. Last winter it had 68 service connections, two of which have 10,000 sq ft. each of radiation connected. The company states that not a single customer has quit taking the service after being connected to the system.

Arrangements for Summer Meeting.

The Illinois Chapter, through a committee composed of J. A. Cutler, chairman; Benjamin Nelson, E. J. Claffey and August Kehm, is busily engaged in the preparation of the local details for the forthcoming meeting of The American Society of Heating and Ventilating Engineers, in Chicago, July 18-20. The government, it is announced, will furnish a large part of the programme through authorized representatives of both the army and navy. Also, features of engineering interest are being arranged for locally, and a special entertainment programme is being arranged for the ladies. Headquarters will be at the LaSalle Hotel.

Kansas City Chapter Takes Up Mechanical Blast Systems of Heating.

Mechanical blast systems of heating were discussed at length before the Kansas City Chapter at its June meeting, held at the Coates House. The meeting was preceded by a chapter dinner. The subject for discussion was divided into three parts: 1.—the design of air washers and ducts; 2.—design of fans and driving mechanism of same; and 3.—the mechanical installation.

Mr. Waddington discussed the development of air washers and stated the first apparatus used to filter air was an ordinary cotton screen. This was succeeded by the coke air washer, in which air was passed through a bed of ordinary coke, which was kept wet with moisture. The coke washer was succeeded by the rain type of washer, where the air passed through a sheet of water, and this type was succeeded in turn by the mist type, in which air passed through a chamber of fine water mist after which it passed through eliminator blades and over scrubbing surfaces, which effectively removed the excess water and dirt.

A modern development of the air washer has been in its use to humidify, as well as to clean the air, and also for use as a cooling medium.

Ducts, he said, should be designed with velocities about as follows:

Fresh air	600	to	1,000	ft.	per minute
Tempering coils	900	to	1,200	"	" "
Main Ducts	900	to	2,000	"	" "
Laterals	900	to	1,200	"	" "
Risers	600	to	800	"	" "
Registers	300	to	500	"	" "

Mr. MacMorran, in discussing the design of fans and driving mechanism, defined tip speed as the velocity of the periphery of the wheel. Static pressure is pressure due to resistance and more properly could be defined as maintained resistance. A propeller or disc type of fan is suitable for low resistance, and with a fan having 1,200 ft. velocity of air through the fan with a free delivery, under a ½-in. static pressure, the velocity would be only 400 to 600 ft. A tip speed of 5,000 ft. or approximately a mile a minute is the maximum for this type of fan. It is better to have a tip speed about 2,500 ft. per minute, but this speed would overcome only a low static pressure. The H. P. increases directly with the resistance, which is opposite to that found in housed fans of the steel plate or multiblade type.

Cased or steel-plate fans show greater efficiency and are more suitable for work under static pressures of around ½-in. and above.

The multiblade type of fan of equal capacity should be operated at about 50% greater speed than the steel plate fan, but the power required to drive a multiblade fan is about 60% that required for a steel-plate fan. Multiblade fans thus take about 15% to 20% less space and require less power than the steel-plate fans of equal size. The advisable tip speed is around 2,900 to 3,000 ft. per minute. Mr. McMorran also stated it was cheaper to drive the fan by engine than by motor, as the exhaust steam from the engine could be sent through the coils and hence the only cost would be that in generating steam at about 25 lbs. pressure, rather than 2 or 3 lbs. pressure.

Mr. McIntyre spoke of the mechanical installation and stated that the main thing to be guarded was to have proper supports for the coils. He advocated reinforced concrete for this purpose. The proper venting of coils was necessary for efficient service and in his opinion 50% of the coils are not properly vented. The arrangement of the steam supply should be such that each coil would get an adequate amount of steam

under all conditions and particularly the outside coil, which has the heaviest duty. The returns from the coils should be separate and so arranged that one coil return could not stop another. He also stated that it was his experience that a good pump and receiver was a great help to a mechanical blast job.

The Kansas City Chapter it was reported, now has about thirty members, with a dozen applications on file. Nine members expressed their intention of attending the summer meeting of the society in Chicago, July 18-20.

National Warm Air Heating and Ventilating Association.

New officers were elected at the annual meeting of the National Warm Air Heating and Ventilating Association, which met in Cleveland, O., June 13. For president, D. Rait Richardson, of New York, succeeds John D. Green, who asked to be released from further duties as president. Mr. Green was made an honorary member of the executive committee. The other new officers are: Vice-president, W. G. Wise, Akron, O.; secretary, Allen W. Williams, Columbus, O. (re-elected); treasurer, Irving L. Jones, Utica, N. Y. Executive committee: E. P. Miller, W. L. Dawborn and George L. Wilkinson. One of the most important actions taken was the discontinuance, for the present, of the association's advertising campaign, one reason being that the trade will take all the warm-air furnaces that can be produced this year.

New Books.

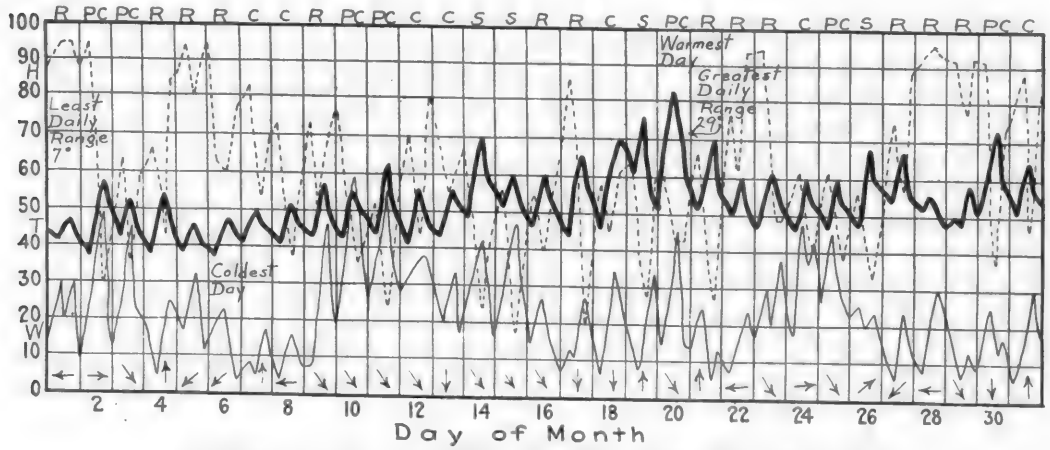
VENTILATION LAWS IN THE UNITED STATES, third edition, containing also the board of health requirements and the regulations of the National Board of Fire Underwriters, together with the model ventilation requirements as promulgated by The American Society of Heating and Ventilating Engineers, has recently been published by the Heating and Ventilating Magazine Company, New York. The volume, with its 178 pages of text, shows in a striking manner, the advance of compulsory ventilation laws, as well as the need for a new compilation. Minnesota, for instance, has adopted a remarkably complete code for school buildings. Indiana has revised its code, as has also New Jersey and Vermont. These and other changes, such as the revision of the Illinois School law and of the Massachusetts building inspection law, are presented in comprehensive abstracts, together with a carefully-compiled abstract of the exhaustive Ohio building code, as far as enacted. A section is given over to the laws regarding the heating and ventilating of industrial buildings, recent revisions being included of the requirements in Tennessee, Illinois, Kansas and New York. The latter takes in the recent rulings of the New York Industrial Commission, made since the enactment of the law, bearing on the matters of heating and ventilation. Finally, the model requirements set forth by The American Society of Heating and Ventilating Engineers, are presented in revised form, supplemented by "General Notes Inserted by the Council" which did not appear in the society's first publication. Size 4 × 6 in.

POWER PLANTS AND REFRIGERATION, being Volume 2 of the important work on "Mechanical Equipment of Buildings," by Louis A. Harding and Arthur C. Willard, has made its appearance and bears out the hopes, to a marked degree, of those who had been awaiting its publication. In order to make the volume more complete, several of the chapters appearing in Volume 1 have been reprinted, including the chapters on heat; water, steam and air; and fuels and combustion. The new volume is modeled on the same broad lines as Volume 1. Manufacturers' data, which have been found useful and reliable, are presented in detail, supplementing the authors' own voluminous data. Special mention should be made of the chapter on "Chimneys for Power Boilers," which is remarkably complete, and also the chapter on "Power Plant Piping." An entire chapter is given over to the "Arrangement of Steam Power Plants," embracing typical layouts in some fifteen different institutions. Other important chapters are those on boilers and rules for construction, mechanical stokers, superheaters and economizers, mechanical draft, feed-water heaters and feed-water purification, steam engines, steam turbines, pumps, steam condensers, cooling ponds and towers, coal and ash-handling machinery, and isolated power plant data. Under refrigeration chapters are presented on units employed in refrigeration practice, heat transmission and construction of cold storage walls, methods of producing artificial refrigeration, cold air, compression and vacuum machines; ammonia condensers, brine circulation system, the ammonia absorption machine and ice-manufacturing plants, including details of a notable installation. Size 7 × 9½ in. Pp. 766, with 496 illustrations, including nine double-page inserts. Bound in flexible leather. Price $5.00. Published by John Wiley & Sons, Inc., New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

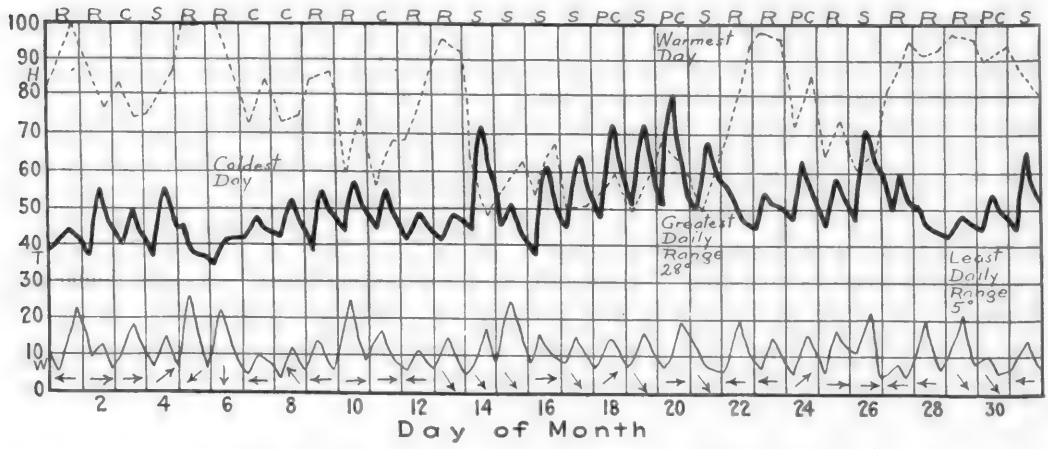
The Weather for May, 1917

	New York	Boston	Pittsburgh	Chicago	St. Louis
Least daily range, degrees F.	82	.80	83	88	90
Date of highest temperature	20	20	19	19	19
Lowest temperature, degrees F.	38	36	36	37	38
Date of lowest temperature	6	6	3	23	5
Greatest daily range, degrees F.	29	28	32	27	26
Date of greatest daily range	20	20	30	29	26
Least daily range, degrees F.	7	5	6	5	5
Date of least daily range	1	29	9	11	3
Mean temp. for month, degrees F.	53*	51	55*	52.6	60.6
Normal mean temp. for month, degrees F.	59.3	56.6	62.6	56.5	66.5
Total rainfall, inches	3.29	4.45	2.65	3.41	3.78
Total snowfall, inches					
Normal precipitation, this month, in.	3.18	3.51	3.30	3.37	4.24
Total wind movement, miles	13753	8303	9685	10101	9917
Average hourly wind velocity	18.5	11.2	13	13.6	13.3
Number of clear days	4	9	4	12	9
Number of partly cloudy days	10	5	4	7	15
Number of cloudy days	17	17	23	12	7
Number of days on which rain fell	18	14	16	16	12
Number of days on which snow fell					
Snow on ground at end of month, in.					

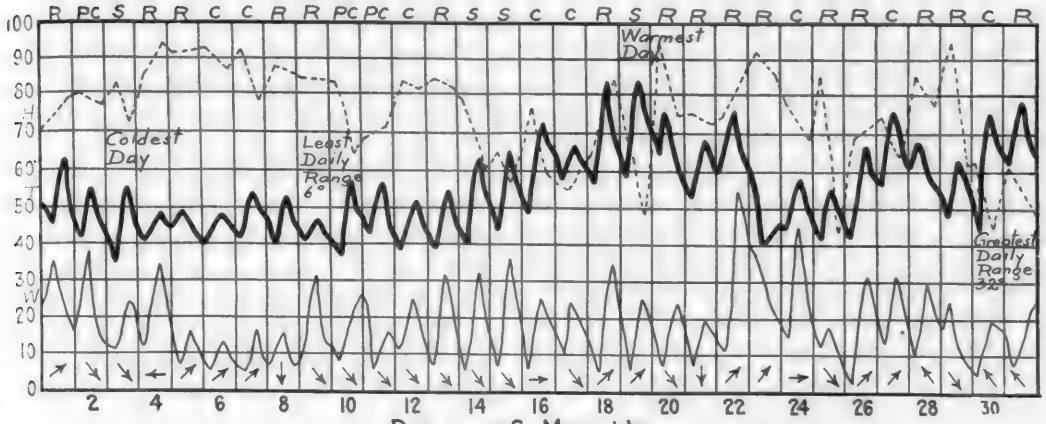
* The mean temperature was the lowest ever recorded by the U. S. Weather Bureau for this month.



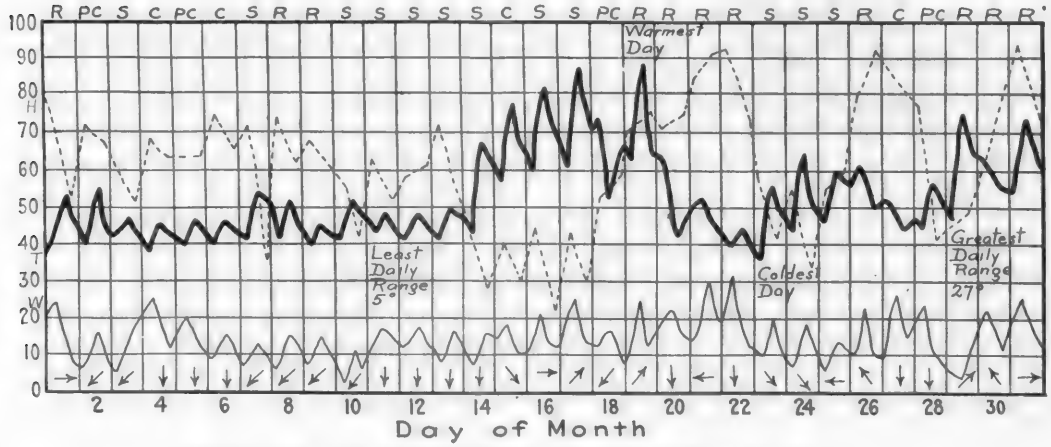
RECORD OF THE WEATHER IN NEW YORK FOR MAY, 1917
(Hourly Observations of the Relative Humidity Are Recorded on this Chart.)



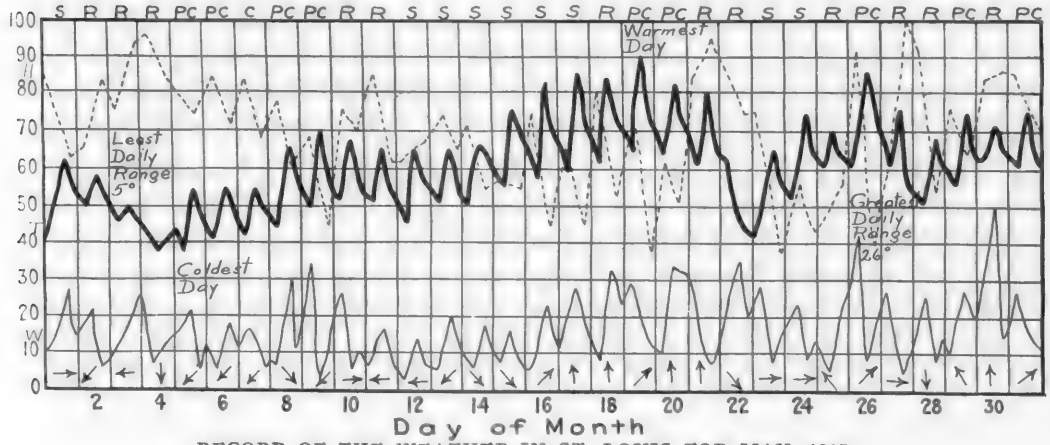
RECORD OF THE WEATHER IN BOSTON FOR MAY, 1917



RECORD OF THE WEATHER IN PITTSBURGH FOR MAY, 1917



RECORD OF THE WEATHER IN CHICAGO FOR MAY, 1917



RECORD OF THE WEATHER IN ST. LOUIS FOR MAY, 1917

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

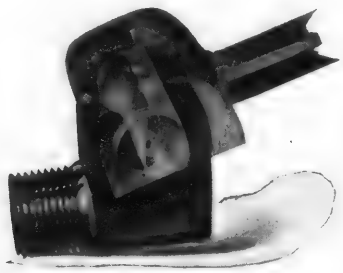
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

Trade Literature.

GUARANTEED CORLISS VALVE STEAM TRAP of the constant-flow type, for every condensation removal service, is featured in a new circular issued by the Plant Engineering & Equipment Co., Inc., New York. On the basis that no trap is better than its valve, special attention is paid to the Corliss valve feature of this trap which prevents the valve from drawing away from its seat, so that there is no wiredrawing or similar trouble. The condensation, however, has a free, unobstructed passage through the valve, and by its rotary or shearing action, the seat is wiped clear of obstructions at each closing. This trap is built for vacuum service and for pressures up to 300 lbs. The circular includes tables of capacities, etc. Size 6 × 9 in. (standard). Pp. 4.



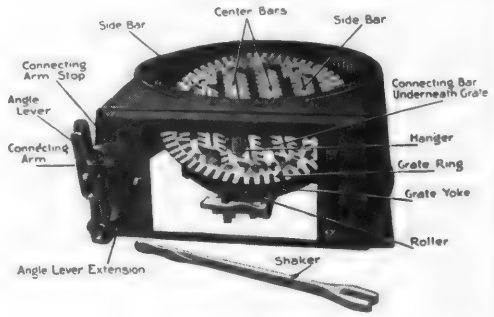
CONSTRUCTION OF VALVE FOR CORLISS VALVE STEAM TRAP.

FIRST HOUSE-HEATING BOILER IMPROVEMENT IN FIFTEEN YEARS is the way a recent bulletin of the National Radiator Co., Johnstown, Pa., describes the three-piece fire-pot of the National Novus boilers. Being made in three pieces, the walls are an even ¼-in. metal thickness, top and bottom, which, it is claimed, means quicker heat at a substantial fuel saving. The rectangular shape, it is added, exposes fully 10% more surface to the fire than other types. The bulletin contains a notable facsimile letter containing the testimony of practical men to the quality and fair business treatment which they have received for nearly a quarter of a century of dealings with the National Radiator Company.

PARKER SASH CHAIN, made by the Parker Supply Co., New York, from a special tempered, cold rolled steel, is brought to the attention of the trade in a newly-issued circular. The full tensile strength of the steel is given to the links by punching them along the grain of the metal. The chain is wound on steel spools made by the Parker compan Each spool contains 500 ft., the standard unit in which this product is sold. The finish varies from bright steel to red metal and brass.

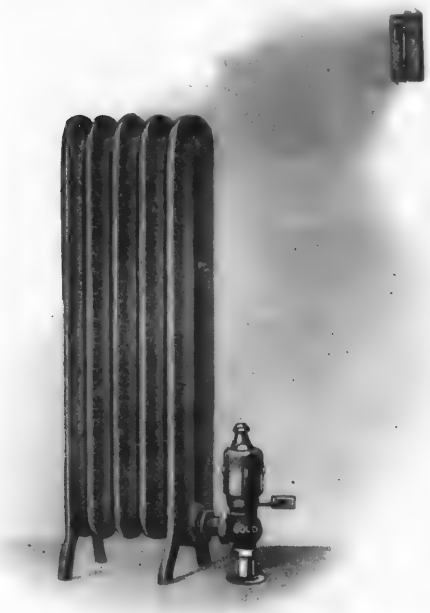
COLUMBIAN VISES AND ANVILS, made by the Columbian Hardware Co., Cleveland, O., are covered in a new catalogue issued by this company. The products includes combination pipe vises, with stationary or swivel bases; hand vises and several types of machinists' vises. Size 6 × 9 in. (standard) Pp. 36.

INTERNATIONAL ECONOMY BOILERS are a new product of the International Heater Co., Utica, N. Y., illustrated and described in a newly-issued catalogue devoted exclusively to this line. These boilers are of the round type and have been put out after a period of rigid tests and investigations covering more than two years. The name "Economy" was chosen because of the efficiency shown throughout the tests These boilers are made in fifteen sizes, with four different diameters of grate, and they are equipped with the new patented Economy every-motion grate. Emphasis is laid on their large coal capacity as well as on their high evaporative power, resulting in a long firing-period of from 8 to 12 hrs The boilers are so designed that the water circulation is positive and the flue passages are arranged so that short-circuiting in passing through the boiler is prevented The "every-motion" grate used with this boiler is found to be equally suitable for all kinds of fuel and operates to clear the fu from the extreme outer edge to the ce ter. It is hung in a drop frame which a be unlatched and the contents of the f e dropped. In shaking the grate the o er rim revolves and at the same time the center bars are agitated with a rocking mo tion. Any bar can be lifted out or dro ped into position without disturbing any other portion of the grate. Size 6¾ × 9¼ in. Pp. 8.



EVERYMOTION GRATE USED IN INTERNATIONAL ECONOMY BOILER.

GOLD'S THERMOSTATIC HEAT REGULATING SYSTEM, for regulating the temperature in buildings, and operated entirely by electricity from the lighting circuit, is illustrated and described in a newly-issued circular received from the Gold Car Heating & Lighting Co., New York. The fact that this method uses no compressed air is emphasized. The system consists of two devices, an electric thermostat, operating contacts by the expansion and contraction of a temperature-sensitive diaphragm, placed on the wall of a room,

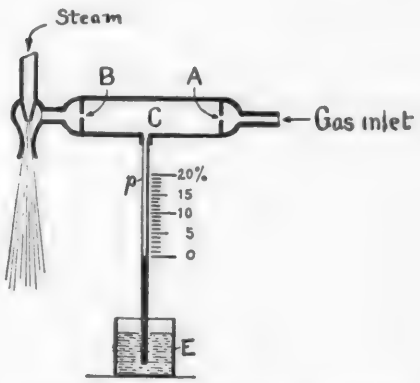


APPLICATION OF GOLD ELECTRO-MAGNETIC VALVE TO RADIATOR.

and a special electro-magnetic valve, which takes the place of the ordinary inlet valve on the radiator. One thermostat, it is noted, will control a number of radiators. The valve and thermostat are connected by electric wires and the operating current taken from the lighting circuit. A volatile liquid sealed in the diaphragm of the thermostat, expanding and contracting with variations in the temperature, actuates a metal strip, thereby opening or closing the electric circuit, as the case may be. Size 3¼ × 6 in. Pp. 8.

KEWANEE FIREBOX BOILERS are the subject of a new catalogue, No. 70, which the Kewanee Boiler Co., the manufacturers state, supersedes everything previously issued pertaining to this line. Special attention is directed to the fact that all Kewanee boilers are now built according to the rules of construction adopted by the A. S. M. E., although slight changes have been made in the details of construction of some Kewanee boilers to make them conform with what has now been accepted as the proper method of building steel boilers. These boilers are regularly constructed for working pressures not exceeding 15 lbs., but those built in accordance with the A. S. M. E. Code are designed for working pressure of from 15 to 100 lbs. The manufacturers, the Kewanee Boiler Co., Kewanee, Ill., state that they have in their yards at present a large stock of boilers and a considerable tonnage from which they can build any sizes not in stock. The catalogue, which contains, as usual, complete data for both the brick-set and portable types, is published on the occasion of the 25th anniversary of the founding of the company. Size 6 × 9 in. (standard). Pp. 32.

UEHLING CO_2 METER, which makes a continuous, rather than intermittent, record of the CO_2 in the flue gases, is the subject of a well-prepared circular issued by the Uehling Instrument Co., Passaic, N. J. The principle of the machine is first described, this being based on the change in pressure, due to a change in volume, in a stream of gas flowing through two apertures. By reducng the gas volume, for instance, between two apertures, A and B, as shown in the accompanying illustration, by absorbing the CO_2 content, a change of pressure is caused in Chamber C which is



PRINCIPLE OF UEHLING CO_2 METER.

transmitted to suitable manometer tubes and recorders calibrated in per cent CO_2. By the application of this fundamental principle in a practical apparatus, it is pointed out, all moving parts, such as motors, counter-weights, etc., are eliminated. The machine proper consists essentially of a cast-iron header and wrought-iron cylindrical regulator, on which are mounted the necessary filters, absorption chamber and the adjusting cocks. Size 6 × 9 in. (standard). Pp. 4.

Standard Heating and Ventilating Data Sheets.

Previously-published data sheets, similar to those appearing in this issue, are as follows:

FEBRUARY, 1917, ISSUE.

No. 1—B.T.U. Losses.
No. 1-A—B.T.U. Losses—Brick.
No. 1-B—B.T.U. Losses—Stone and Concrete.
No. 1-C—B.T.U. Losses—Combinations.

MARCH, 1917, ISSUE.

No. 1-D—B.T.U. Losses—Tile.
No. 1-E—B.T.U. Losses—Frame Construction.
No. 1-F—B.T.U. Losses—Glass, Skylight and Miscellaneous.
No. 1-G—B.T.U. Losses—Ceiling, Floor and Roof.

APRIL, 1917, ISSUE.

No. 2—Exposure.
No. 3—Leakage.
No. 4—Temperature Range.
No. 4-A—Temperature Range.

MAY, 1917, ISSUE.

No. 5—Computing Heat Losses.
No. 6—B.T.U. Example of Computation.
No. 7—Ventilation.
No. 8—Air Changes—Churches and Theatres.

JUNE, 1917, ISSUE.

No. 8-A—Air Changes—Hospitals.
No. 8-B—Air Changes—Hotels and Libraries.
No. 8-C—Air Changes—Schools.
No. 8-D—Air Change—Miscellaneous.

Copies of these sheets, printed separately on one side only, may be obtained at 5 cents each. The attention of readers is also called to the special binder furnished by the Heating and Ventilating Magazine Company for holding these sheets. The price of these binders, bound in brown duck, with strong spring clasp, is $1.00, post paid.

Readers will kindly take notice that the sheets will not always appear consecutively numbered. For instance, where a large number of sheets, such as those on radiators, fall under the same key number, they will be interspersed with sheets on other subjects. The complete series, however, will have each subject listed under its proper number.

Erratum—Sheet No. 8-A, in the June issue on "Air Changes—Hotels and Libraries" should be No. 8-B.

Deaths

SIDNEY R. SHELDON, vice-president and chief engineer of Sheldons, Ltd., Galt, Ont., died at his home in Galt, May 7.

JAMES M. JOHNSON, treasurer of James B. Clow & Sons, Chicago, died at his home in that city, June 10. Mr. Johnson was 69 years old and had been ill several months. He had been identified with the Clow company since 1885.

WILLIAM W. GREEN, president of the Garden City Fan Co., Chicago, died in Niles, Mich., June 2. He was 79 years old. The immediate cause of death was uraemic poisoning, although he had long been confined to his rooms. Mr. Green was born in Williamstown, Mass. He came to Chicago in 1882 and made that city his home until 1902 when the plant of the Garden City Fan Company, of which he was president and active manager, was moved to Niles. Since that time he divided his time between Niles and Chicago. Mr. Green's generosity was proverbial. He liked to entertain his friends, while his gifts of property in aid of relatives and, in some cases, of old friends, were many. He is survived by one sister and one son, Ed. Green, who will continue the management of the business. On the day of Mr. Green's funeral the business houses were closed between 10:30 and 11:30 a. m. at the request of Mayor Troost.

National Association of Sheet Metal Contractors

National Association of Sheet Metal Contractors, which met in Cleveland, June 12, re-elected George Harms, of Peoria, Ill., as its next president. Attention was called in the president's address to the growing use of sheet metal in ventilating work and he urged the sheet metal contractor to get in closer touch with this field.

Eastern Supply Association

Eastern Supply Association, which met in New York, June 20, was favored with an address by George D. McIlvaine, secretary of the National Pipe and Supply Association, on the subject of "How Can We Conserve a Reasonable Proportion of the Profits?" He urged closer co-operation between the manufacturers and the jobbers. He was followed by George H. Van Arnam who delivered an address on "Building Young Men for Business." At the afternoon session, Job E. Hedges spoke in a patriotic vein on "United States Before the World."

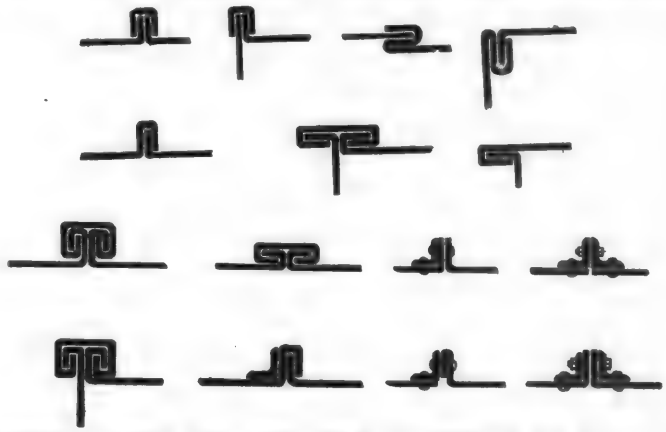
PROPERTIES OF AIR

Temperature Degrees F.	Vol. of Dry Air with Unity at 32° F.	Cubic Feet in 1 lb. of Air	Weight of 1 cu. ft. of Dry Air	Elastic Force of Vapor. in. of Mercury	Cubic Feet of Vapor from 1 lb. of Water	B.T.U. Absorbed by 1 cu. ft. of Air per Deg. F.		B.T.U. Absorbed by 1 cu. ft. of Air per Deg. F.	
						Dry Air	Sat. Air	Dry Air	Sat. Air
Zero	0.935	11.58	0.0864	0.044	.....	0.02056	0.02054	48.5	48.7
12	0.960	11.87	0.0842	0.074	.....	0.02004	0.02006	50.1	50.0
22	0.980	12.14	0.0824	0.118	.....	0.01961	0.01963	51.1	51.0
32	1.000	12.40	0.0807	0.181	3289	0.01921	0.01924	52.0	51.8
42	1.020	12.64	0.0791	0.267	2252	0.01882	0.01884	53.2	52.8
52	1.041	12.88	0.0776	0.388	1595	0.01847	0.01848	54.0	53.8
60	1.057	12.93	0.0764	0.522	1227	0.01818	0.01822	55.0	54.6
62	1.061	13.13	0.0761	0.556	1135	0.01811	0.01812	55.2	54.7
70	1.078	13.34	0.0750	0.754	882	0.01777	0.01794	56.3	55.5
72	1.082	13.39	0.0747	0.785	819	0.01767	0.01790	56.5	55.8
82	1.102	13.64	0.0733	1.092	600	0.01744	0.01770	57.2	56.5
92	1.122	13.90	0.0720	1.501	444	0.01710	0.01751	58.5	57.1
100	1.139	13.95	0.0710	1.929	356	0.01690	0.01735	59.1	57.8
102	1.143	14.14	0.0707	2.036	334	0.01682	0.01731	59.5	57.8
112	1.163	14.40	0.0694	2.731	253	0.01651	0.01711	60.6	58.5
122	1.184	14.65	0.0682	3.621	194	0.01623	0.01691	61.7	59.1
132	1.204	14.90	0.0671	4.752	151	0.01596	0.01670	62.5	59.9
142	1.224	15.15	0.0660	6.165	118	0.01571	0.01652	63.7	60.6
152	1.245	15.40	0.0649	7.930	93.3	0.01544	0.01634	65.0	61.5
162	1.265	15.65	0.0638	10.099	74.5	0.01518	0.01616	66.2	62.4
172	1.285	15.90	0.0628	12.758	59.2	0.01494	0.01598	67.1	63.3
182	1.306	16.17	0.0618	15.960	48.6	0.01471	0.01580	68.0	64.2
192	1.326	16.42	0.0609	19.828	39.8	0.01449	.....	68.9	.....
202	1.347	16.67	0.0600	24.450	32.7	0.01426	.....	69.5	.....
212	1.367	16.92	0.0591	29.921	27.1	0.01406	.....	71.4	.....

DUCT AND FLUE WORK.

Ducts and flues for heating and ventilating are usually constructed of galvanized iron or masonry. When galvanized iron is used they may be round or oblong in shape and are often built of No. 24 U. S. Gauge up to 350 sq. in. of area; No. 22 U. S. Gauge from 351 to 1200 sq. in. of area and No. 20 U. S. gauge above this, with suitable stiffners. Casings for heaters, fan connections, fresh air intakes and other large compartments are usually built of No. 18 U. S. gauge.

Ducts and flues are generally made in the shape of sections and joined up on the job, special connections being installed after the main lines are in place. There are various methods employed by different contractors for joining the various sections, some of the more common types being here illustrated. For smaller work the use of an angle iron is unnecessary, the standing seam giving all the stiffness required for short spans, but for spans over 4 ft.—and certainly for spans over 6 ft.—angle irons are most desirable.



Some engineers specify that ducts shall be stiffened "so as to bear the weight of a man on a plank laid along the top at any location selected." Flat seams are little used in good work unless the size of the pipe is 12 in. or less.

Round pipes, from a purely efficiency standpoint, are always the best, the amount of metal required to furnish a given amount of air at a given velocity being less and the friction or resistance to the passage of the air also being reduced. In factories, shops and other industrial buildings round ducts and flues are the rule; in better classes of buildings, where space is at a premium, square or rectangular flues are used almost exculsively. The length of the long side of a rectangular flue should never be more than twice the length of the short side unless absolutely unavoidable.

Volume dampers should be placed so as to control with absolute certainty the quantity of air delivered to each outlet or inlet and it is impractical to try to design a system where such dampers are not needed.

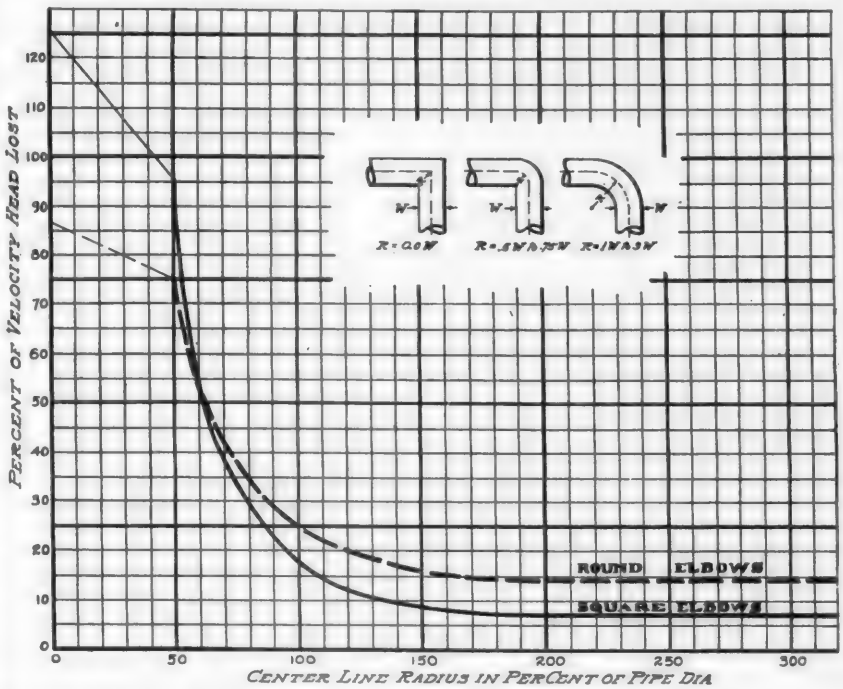
Ducts and flues may be sized by two different methods:

(*a*) By assuming velocities in the pipe (according to its position in the system) and calculating to find its area, or

(*b*) By assuming a proportional area of pipe to the area of the fan discharge and calculating all pipe areas on the basis of the equivalent number of 1-in. pipes.

ELBOWS AND BENDS

All bends and elbows should be made with a center line radius of not less than one and one-half times the width of the pipe and some prefer using two times the pipe width. Tests



with elbows of various radii by Frank L. Busey and read before the A. S. H. & V. E. in 1913 indicate that the resistances vary as shown on the following curves. From these curves it can be seen that little is gained beyond one and one-half times the width and nothing at all beyond two times the width.

ANEMOMETER READINGS

The following is the method recommended by the committee appointed in 1913 by the A. S. H. & V. E. to investigate and recommend a standard method of obtaining anemometer readings of air velocities and quantities at supply and vent registers. The committee decided that all special apparatus, such as cones, plates, etc., was impractical and formulated seven rules as follows:

1. The opening shall be divided into equal rectangular areas, no side of which shall be over 10 in. long, excepting where this would require more than ten readings, in which case the opening shall be divided into twelve equal areas.
2. Readings are to be taken in every case at the center of every area.
3. Readings are to be one-half-minute duration, the anemometer being held at the register face or in the plane of the opening.
4. Where the diffusers are used, a total area is to be computed on the basis of the periphery of the diffuser.
5. The average of the readings are to be considered as the average velocity at the opening. Where negative velocities are found, they are to be deducted in arriving at the average velocity.
6. In computing volume, the net area of opening is to be taken, the volume to be considered as the product of the average velocity and the net area of the opening.
7. If the anemometer is held 2 in. from the register face, no deduction shall be made for the area occupied by the register mesh.

Advantages of wall radiators

These compact and efficient radiators have rapidly won the favor of architects for use in factories, apartments, theaters, hotels, office buildings and large residences.

A clever arrangement of AMERICAN Rococo Wall Radiators on a column

AMERICAN Rococo Wall Radiators

can be erected on walls, ceilings, skylights, in narrow passage ways, basements, around windows and on girders—in fact in any space which cannot be used for anything else. Easily erected in small units and capable of quick re-arrangement. When weather is mild the units can be shut off, thus preventing waste and over-heating.

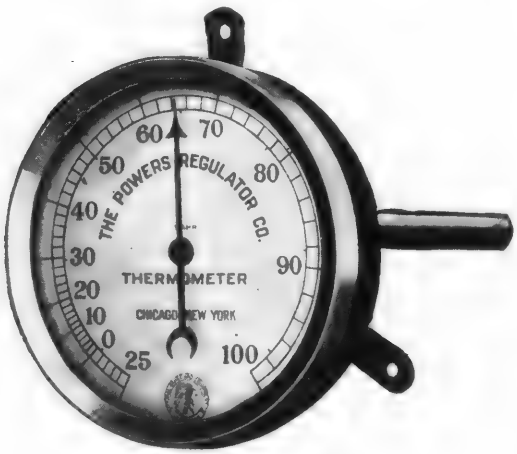
Send for catalog "American Rococo Wall Radiators"—shows many interesting installations and gives convincing data as to the efficiency and economy of AMERICAN Rococo Wall Radiators

AMERICAN RADIATOR COMPANY

Sales branches and showrooms in all the large cities

Reliable-Readable Reasonable

The ordinary mercury duct thermometer is hard to read. This Powers Thermometer has a white dial with large black figures that can almost be read in the dark. It costs no more than a good mercury thermometer.



Reliable, Readable and Reasonable; designed especially for ventilating work. Three dials only, 25° to 100°; 40° to 140°; 100° to 200°—Fahr. scale.

Send for Bulletin 140, with complete information.

The Powers Regulator Co.

Temperature Control Specialists

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Canadian Powers Regulator Co., Ltd., Toronto, Ont.

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TRADE AND MISCELLANEOUS NOTES

Coming Events.

July 18-20, 1917.—Summer meeting of The American Society of Heating and Ventilating Engineers, in Chicago, Ill. Headquarters at the Hotel La Salle.

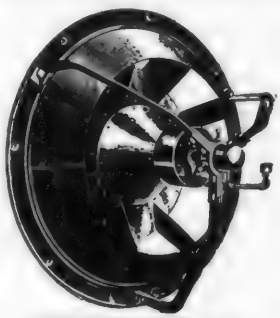
Miscellaneous Notes.

Central Supply Association held its 74th regular meeting in Detroit, Mich., June 13, at the Hotel Statler. Considering the war conditions the attendance was remarkably large. President Wolff expressed the sentiments of many when he stated that just now, of all times, was it necessary for the general trade interests to be in personal touch and close co-operation for handling the acute problems that will continually arise. One of the principal speakers was George F. Monaghan, of Detroit, general counsel and legal advisor of the National Founders' Association. Mr. Monaghan's subject was "Public Sentiment," with special reference to its power on the life, business activities and politics of the nation.

U. P. C. Book Co., Inc., 241-249 West 39th Street, New York, has been formed to take over the book business of a number of publications, including the David Williams Co., *the Iron Age,* and the *Metal Worker.*

Youngstown, O.—Paul Boucherie, architect to the Youngstown Board of Education, has engaged A. D. Alexander, of the Pittsburgh office of the R. D. Kimball Co., heating engineers, to prepare plans and specifications and supervise the installation of heating and ventilating apparatus in the schools to be built under Mr. Boucherie's supervision during the present year.

Paris, France.—The production of coal from French mines, it is announced, has increased 500,000 tons per month, as compared with the last month of 1916. 7,000 more miners, given leave from the front, to aid



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HOWARD & MORSE
45 FULTON ST., N. Y.
Ventilating Engineers and Contractors
MANUFACTURERS OF
BLACKMAN and DUPLEX CONE FANS

which are installed by us complete with **Motors, Duct Work** and **Wiring.**

Aligning, Rigging and **Hoisting** done, with labor thoroughly qualified from long experience.

We make a specialty of **Kitchen Exhaust** work. Prominent buildings, hospitals, theatres, and private residences are among our many and recent installations.

The **Duplex Cone** Fans are semi-conoidal fans, made especially to operate against pressure in duct systems.

The **Blackman** Fans are used for fresh air delivery and in duct systems, when no great pressure is involved.

You can have the advantage of our experience.

SEND FOR CATALOGUE

BLACKMAN FAN
Direct Connected to Motor

in this work, will, it is expected, increase this gain. As a result the heating problem for the coming winter in France, though still difficult, is taking on a less serious aspect. A greater use of wood for heating next winter is advocated. Exportation having been stopped, stocks have accumulated during the war, in spite of the drafts made upon woodmen by the mobilization. Experts figure that, by providing enough woodmen to work up the available timber, firewood may be provided in abundance to take the place of coal and to be sold at 100 francs a ton.

Flint, Mich.—Explosion of an enameling furnace in the new Chevrolet four-ninety plant recently blew out the steel-window sash for half the length of the 600-ft. building, besides wrecking the interior of the building. No deaths were caused by the accident.

Radiator Lists and Discounts published on May 21 show the prices to be practically double former prices. The changes in boiler prices is proportionately as marked.

Building Operations for May, 1917, fell off 34% from the figures for a similar period in 1916. The totals for 113 principal cities, as compiled by the *American Contractor*, Chicago, were $75,168,153, as against $114,331,891 for May, 1916. As exceptions to the general run of losses, gains were made by Baltimore (64%), Cincinnati (126%), Cleveland (18%), Des Moines (29%), Erie (298%), Dayton (16%), Kansas City (3%), Milwaukee (14%), Newark (39%), Omaha (5%), Pittsburgh (28%), Richmond (116%), San Francisco (77%), Seattle (101%), Sioux City (366%), St. Louis (5%), St. Paul (2%), and Washington, D. C., (38%). New York City's loss was 73%, from $28,516,421 to $7,773,116. Chicago's loss was 50%, from $13,707,100 to $6,552,800.

Martin A. Rooney, formerly smoke inspector of Nashville, Tenn., has been appointed sales engineer for the Detroit branch of the American Radiator Company. Mr. Rooney's headquarters are now in Detroit.

Merchants' Association of New York is calling the attention of out-of-town manufacturers to the fact that those contemplating locating in New York City and who may find the problem of finding the best location an intricate and puzzling one, would do well to apply to the Merchants' Association, which will gladly aid them in selecting a location best suited to their requirements. The association is also prepared to furnish them with information concerning the industrial factors with which they may be concerned. It is pointed out

Install the WEBSTER System in your New or Old Building this Summer, and you will not Experience any Heating Troubles next Winter. It will give you Efficient and Economical Heating Service.

The WEBSTER System is a method of circulating exhaust steam, live steam, or a combination of the two, to obtain not only the utmost efficiency, but the greatest economy.

Wasting exhaust steam, which might be put to profitable use in heating, is actually throwing money away, since all exhaust steam not so utilized requires additional live steam to be generated, at the expense of fuel and labor, besides the extra wear on the power plant

Webster **VACUUM SYSTEM OF STEAM HEATING**

has been installed in over 10,000 buildings during the past 29 years. This record has been achieved only by giving uniformly successful results.

The WEBSTER System is adapted to the heating problems of the manufacturer, whether his factory is housed in a single building or in an extended group of buildings.

Old buildings can be "Websterized," very often at comparatively little expense.

The WEBSTER System overcomes excessive coal bills, nerve-racking "water-hammering," odor, noise, etc. Circulation of the steam is secured with little or no back pressure upon the engine. The Webster Modulation Valves control the temperature in each room or department.

Let us explain to you how the WEBSTER System will prove efficient and economical.

Write us today. Ask for Catalogue V-37

WARREN WEBSTER & COMPANY

MANUFACTURERS OF Webster Systems of Steam Heating, Webster Feed Water Heaters, Webster-Lea Heater-Meters, Webster Steam and Oil Separators, Webster Steam Specialties

MAIN OFFICE AND WORKS ESTABLISHED 1888 — **CAMDEN, NEW JERSEY** — POINT AND PEARL STS BRANCH OFFICES IN PRINCIPAL CITIES

that the industrial district of metropolitan New York contains 20 important cities and many smaller communities, in addition to the five great boroughs of Greater New York. At a recent election, President William Fellowes Morgan was re-elected president of the association.

University of Wisconsin, Madison, Wis., announces its nineteenth annual summer session of the College of Engineering, beginning June 25. Special courses are being given in chemistry, electrical, steam and hydraulic engineering, gas engines, shop work and surveying. Special courses have also been arranged for engineering, manual arts and vocational teachers. Further information may be obtained from F. E. Turneaure, dean, Madison, Wis.

Central Station Heating Notes.

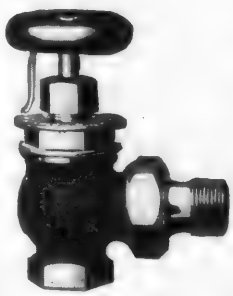
Des Moines, Ia.—The heating franchise election in Des Moines is still under investigation by the grand jury. The four missing registration books in the first four precincts of the first ward have never been found. There is a question whether the probe might affect the result of the election, which was favorable to the granting of the heating franchise, or whether criminal prosecutions would be the logical outcome.

Davenport, Ia.—H. C. Blackwell, general manager for the People's Light Company, appeared before the city council May 16 to ask for permission to increase the company's rates for heat. The increase in the cost of coal and other things, he stated, made it necessary to increase the rates or suffer a loss of $10,000 next winter. He added that if the increase were not granted the company would have to cut down the service.

Youngstown, O.—The plant of the Youngstown Heating Company which operates a steam heating service, has been sold to the Mahoning & Shenango Railway & Light Co., which will immediately take over the property. The sale was due to the high cost of fuel and labor. The Mahoning & Shenango Railway Company will operate the system from the North Avenue electric generating station. This arrangement, it is stated, will permit the system to be operated at a profit.

Kenosha, Wis.—Kenosha may lose the distinction of being the only city in Wisconsin with a community heating system. The Wisconsin Gas & Electric Company has appealed to the railroad commission to permit it to abandon this feature of its business. In its petition it declares that the heating plant is worn out and that the reserve for depreciation has not been sufficient to rebuild it. Many houses in Kenosha are heated from the city plant.

New Ulm, Minn.—According to plans drawn by the Charles L. Pillsbury Engineering Co., of Minneapolis, the central heating system in New Ulm will be extended the full length of the block on the west side of Minnesota Street, from Center



Jenkins Bros. Fractional Radiator Valves

for atmospheric, vacuum or vapor systems. Make it a simple matter to throttle the steam supply so that any portion of the radiator may be heated to suit the user. A five-sixths turn opens them fully. The Jenkins Bros. Standard in design, metal and workmanship insures durable, dependable service.

Jenkins Bros.

New York Boston Philadelphia Chicago Montreal London

STANDARD THERMOMETERS - Indicating and Recording

for VACUUM, STEAM and HOT WATER SYSTEMS, BAKE OVENS and COLD STORAGE PLANTS. SEVEN models of RECORDING and EIGHT of INDICATING Thermometers. All Accurate, Durable and Legible.

Backed by thirty years of Thermometer manufacturing.

They are practically indestructible, are sensitive to changing temperatures and are very easily installed. Supplied with horizontal or vertical extension and standard pipe thread.

Ask for catalog No. 100-107 and trade prices.

STANDARD THERMOMETER COMPANY, 65 Shirley St., Boston, Mass.

to First South Street, and the full length of the block on the west side of the same street, from Second North to Third North Street; also from Second North Street, on the east side of Minnesota Street, to and including the Grand Hotel. The plans for the extension were made after the engineers had reported that it could be enlarged 50% without impairing the service and that the consumption of live steam would not be too great to interfere with the operation of the municipal electric light and water plant. The system has operated at a profit during its first season, a record that is considered exceptionally good.

Sibley, Ia.—William T. Bain, of the Milwaukee Conduit & Insulation Co., Milwaukee, Wis., and J. E. G. Robb, of Minneapolis, have closed a contract at Sibley for extensions to the central heating plant in that place, to cost $15,000. It is stated that no competition was asked, nor other bids received for this work, which is to be both designed and installed by Messers. Bain and Robb.

Cleveland, O.—Cleveland's municipal steam heating system was operated at a loss of $10,754 in 1916, according to a report made public by the city department of finance. Although the earnings of the plant in 1916 exceeded those of 1915 by $10,000, the increased cost of fuel and a higher depreciation cost more than offset this gain in business. The earnings last year were $44,018.11 and the earnings in 1915 were $34,392. The total cost of operation last year was $54,772.55. In 1915 the plant was operated at a loss of $333.27. Public Utilities Director Farrell, it is stated, believes the heating plant should be combined with a municipal ice plant. In his opinion, it is added, the two utilities operating together would wipe out the present loss. The heating plant is now operated by the water department.

Bloomington, Ill.—A petition is being circulated in Bloomington for the adoption of a central station heating franchise. Bloomington, it is pointed out, has the best steam coal in the country and an abundance of water on the proposed site for the plant. The petition reads as follows:

"Immense earnings and profits are being made in the operation of industrial plants. The men that reap the big harvests are the ones who get in on the ground floor.

"Heat, light and power are a necessity and not a luxury. Every one is compelled to have it one form or another. To produce this economically it must be done on a large scale and by improved and scientific principles.

There is a Temperature and Relative Humidity

at which we are most comfortable—where unconsciously we are most efficient

HIGH TEMPERATURE CAN BE REDUCED

The Child at school can study best, the Grown Ups and the Children too can assimilate Knowledge, and where we can all enjoy our pastimes and amusements —whether we be in school or church, at theatre or taking our evening meal at hotel or cafe—the sense of comfort governs the degree of pleasure or receptiveness and health ensues where life is spent in such surroundings.

EXCESSIVE HUMIDITY CAN BE LOWERED

Psychological investigation resulted in the establishment of a comfort zone.

COMFORT AND EFFICIENCY ZONE

Mathematical calculation enables us to determine just what apparatus is needed for each installation

Mechanical design has produced the means by which results can be secured

COLD AIR CAN BE INCREASED IN TEMPERATURE

Braemer Air Conditioning Corporation

411 Lafayette Bldg., Philadelphia, Penna.

New York Chicago

LACK OF HUMIDITY CAN BE SUPPLIED IN PROPER PROPORTIONS

Air Purifying **Humidifying** **Low Temperature Drying**

Air Cooling **Dehumidifying** **High Temperature Drying**

Industrial Ventilating Problems **Temperature and Humidity Regulation**

WEBSTER AIR WASHERS

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

DETROIT PACKLESS RADIATOR VALVES

The Correct Valve for the Beautiful Home

Detroit Packless Valves are finished with the definite purpose, that they shall harmonize with the most beautiful surroundings. In addition to their unusually pleasing appearance and smooth satin finish they are permanently efficient and will not leak or need repacking.

Booklet VP-1 Gladly Sent Upon Request

DETROIT LUBRICATOR COMPANY
DETROIT, U. S. A.
CANADIAN DETROIT LUBRICATOR COMPANY, LTD. WALKERVILLE, ONTARIO.

LARGEST MANUFACTURERS OF RADIATOR VALVES IN THE WORLD

"By our present methods we are not getting over 70% heat units out of our coal. The 30% is wasted in gases and smoke and unburned coal that is carted to the dump. You will eliminate the smoke nuisance and the ashes that are dumped into your alley to be carted away at a big expense.

"If Bloomington citizens expect to get their necks from under a heavy yoke now is the time to act, as foreign capital is seeking to get control of all utilities plants.

"If you are in sympathy with the movement and will attend a meeting for the

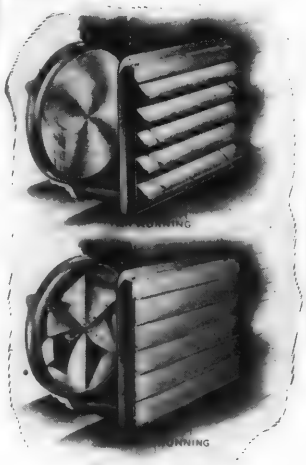
"Those that use steam power and throw the exhaust in the air are losing 93% of the heat units. Ninety per cent of this can be used for heating your homes at a moderate cost."

Manufacturers' Notes.

Turner Heating Co., Hartford, Conn., manufacturers of tin roofing, sheet iron fixtures, etc., has passed under the control of F. Clinton Stark, who has been manager of the plant for the past 15 years.

R. B. Hayward Co., Chicago, Ill., manufacturers of ventilating apparatus, will

I L G
SELF-COOLED MOTOR PROPELLER FANS AND AUTOMATIC SHUTTERS



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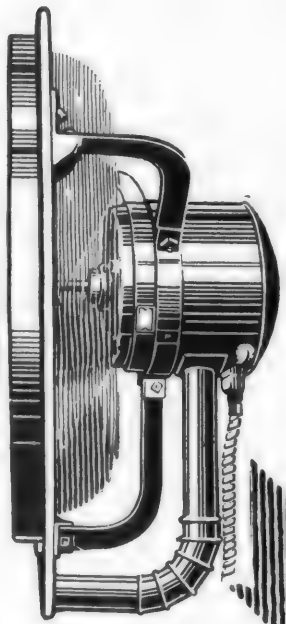
For the Ventilation of Restaurants, Theatres, Offices, Factories

Low in Power Consumption
Quiet Running



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I L G Electric Ventilating Co.
158 Whiting St. CHICAGO
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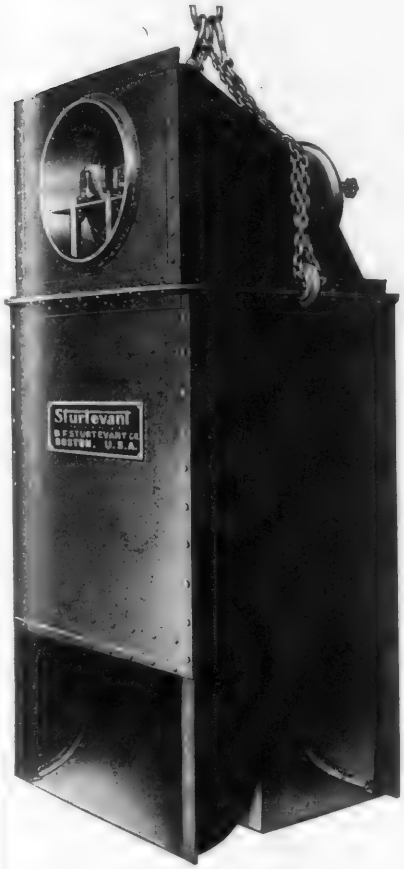


Sturtevant
(REG. U. S. PAT. OFF.)

Individual Heater Units for Shop Heating

Illustration shows small self-contained heating unit with turbine-driven disc fan. These units diffuse large volumes of warm air along the floor, and are ideal for heating shops, roundhouses, industrial buildings, pump-houses or oil-houses.

Advantages:

Inexpensive—self-contained—require only one steam pipe—exhaust steam from turbine used in coils—can be moved by crane or truck to other location or plant—can be readily sold—belt-drive or motor-drive is readily possible.

Full information on request

B. F. STURTEVANT COMPANY
HYDE PARK, BOSTON, MASSACHUSETTS

And All Principal Cities of the World

occupy new quarters at 853 West Ohio Street. The new building was to be ready for occupancy July 1.

Buffalo Forge Co., Buffalo, N. Y., has received an order from the National Acme Co., Cleveland, O., for its heating and ventilating equipment, which, it is stated, will be the largest of its kind in a building under one roof, heated and ventilated by a fan system. The equipment consists of four Carrier type A air washers, with automatic control and fresh and return air dampers; four Niagara Conoidal supply fans, two of which deliver 100,000 cu. ft. of air per minute each; four exhaust fans, two of which will handle 70,000 cu. ft. of air each, and two 50,000 cu. ft. of air per minute each; 10 Baby Conoidal fans for toilets; 27,000 sq. ft. of Vento heaters and four 12-in. × 14-in. steam engines for driving the fans. George S. Rider & Co., are the consulting engineers.

Cleveland, O.—As announced last month, the Bishop-Babcock-Becker Company, of Cleveland, O., manufacturers of the Reliable air line and return line vacuum and vacu-vapor heating systems, has purchased the heating and engineering department of the E. F. Houghton & Co., Philadelphia, Pa. Difficulties experienced by the Houghton company in securing raw materials, and machinery and tools, together with the labor situation, made it advisable to sell. The sale, it is stated, was only made, however, when it was found that the Bishop-Babcock-Becker Company had the facilities for continuing the Houghton lines in a satisfactory manner with an adequate engineering organization. The Houghton specialties, which will now be manufactured by the Bishop-Babcock-Becker Company in its Cleveland plant, consist of the Houghton system of vapor heating, American system of heat control, Houghton Therm valve, float trap, pump controlling valve, pressure reducing valve and balance float valve. The agency for the Marck Therm steam trap also passes to the Bishop-Babcock-Becker Company.

Utica Heater Co., Utica, N. Y., has appointed J. K. Simkins as sales manager. Mr. Simkins was formerly with the International Heater Company, Utica, N. Y., acting in a similar capacity.

John Simmons Co., New York, will furnish the steam heating and power appliances for the Hotel Commonwealth, which will occupy the entire block front in the Times Square district of New York. The extent of the order will be realized when it is stated that this structure will be the largest hotel in the world, rising 28 stories and containing 2,500 rooms. The hotel will cost $15,000,000.

Metal Sylphon Diaphragm Valves

ORIGINATED WITH THE

Johnson System of Temperature Regulation

The Pioneer System and Leader in Improvements

Untested imitations and substitutes followed fast but, having been thoroughly tested and proved equal to the demands,

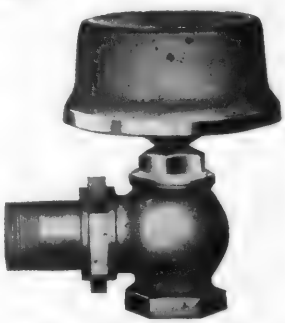
The SYLPHON is the Recognized Standard

It costs no more to install the JOHNSON SYSTEM than inferior products, so why assume the risks?

Communicate with our nearest branch in regard to your temperature regulation requirements.

Our co-operation is yours for the asking.

You can reach us overnight



The indestructible sylphon metal diaphragm valve

THE JOHNSON SERVICE COMPANY

New York Chicago Boston Kansas City San Francisco

L. O. Koven & Bro., Jersey City, N. J., had a flag-raising at their plant in Jersey City, May 19. 500 employees of the company participated in the ceremony which included a parade through West Hoboken. The speakers were Congressman Thomas McEwen of Jersey City and L. O. Koven, and G. H. Koven.

American Radiator Co., Chicago, Ill., will build an addition to its plant in Buffalo at Elmwood and Hertel Aveniew Avenues. The addition will be 100 ft. × 200 ft.

H. **W. Johns-Manville Co.,** New York, has moved its Pittsburgh showrooms and sales offices to larger quarters on the ground floor of the Westinghouse Building, at Ninth Street and Pennsylvania Avenue.

Nye **Tool & Machine Works,** Chicago, is completing an enlargement of its plant and installing additional equipment which will double its capacity.

National **Tube Co.,** Pittsburgh, Pa., has opened an employment bureau in Pittsburgh, at 419 Fourth Avenue.

New Incorporations.

Johnson **Kitchen Ventilator Co.,** Chicago, Ill., capital $1,400. Incorporators: Harvel

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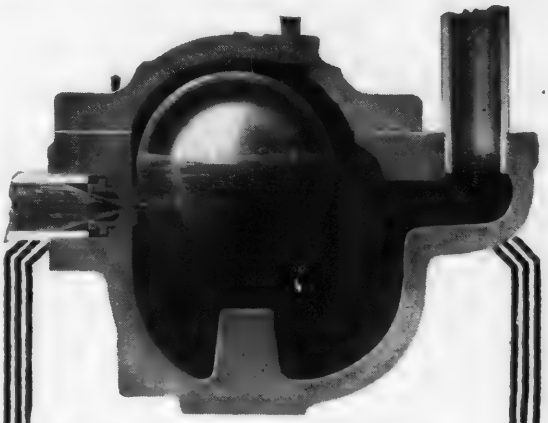

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Nodor Incinerating Co., Detroit, Mich., capital $5,000, to manufacture water heating garbage burners. Stockholders: F. P. Goettman, B. A. Koppitz and Alfred Roseroot.

Furst Plumbing & Heating Co., Richmond Borough, New York, capital $10,000. Incorporators: H. I. Neuschafer, C. S. Ashley and D. J. Dowling, 15 John St.

Densmore Plumbing & Heating Co., Toledo, capital $10,000. Incorporators: James D. Densmore, Aaron Chesebrough, E. M. Salter, Fred Gruber and Lindley W. Morris.

Crawford Co., Chicago, Ill., capital $50,000, to manufacture and deal in heating and plumbing appliances.

Hart Mfg. Co., Louisville, Ky., capital $60,000, to manufacture and install heating and ventilating plants, drinking fountains, playground apparatus, dairy supplies, etc. Incorporators: T. W. Vinson, H. K. Cole and R. E. Gordon, of Louisville; and L. N. Reeder of Jeffersonville.

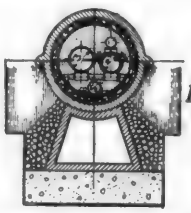
Schueler Ventilator Co., Bloomington, Ill., capital $25,000. Incorporators: Frederick Schueler, Edwin R. Schueler and Oscar H. Schueler.

MacKinnon Plumbing and Heating Co., Detroit, Mich., capital $2,000. Shareholders: Alex. J. MacKinnon, Josephine A. MacKinnon and J. Shurly Kennary.

Bunting Boiler Co., Chicago, Ill., capital $300,000, to manufacture boilers and heating specialties. Incorporators: J. T. Bunting, J. G. Burns and C. W. Shaeffer.

Neiman Heater Co., New York, capital $10,000, to manufacture heating boilers. Incorporators: Alvin B. Neiman, Hugh Wabst and Alfred Nutt.

Faber Mfg. Co., Chicago, Ill., capital $200,000, to manufacture air conditioning and regulating systems. The company has



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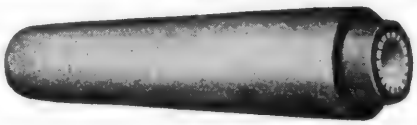

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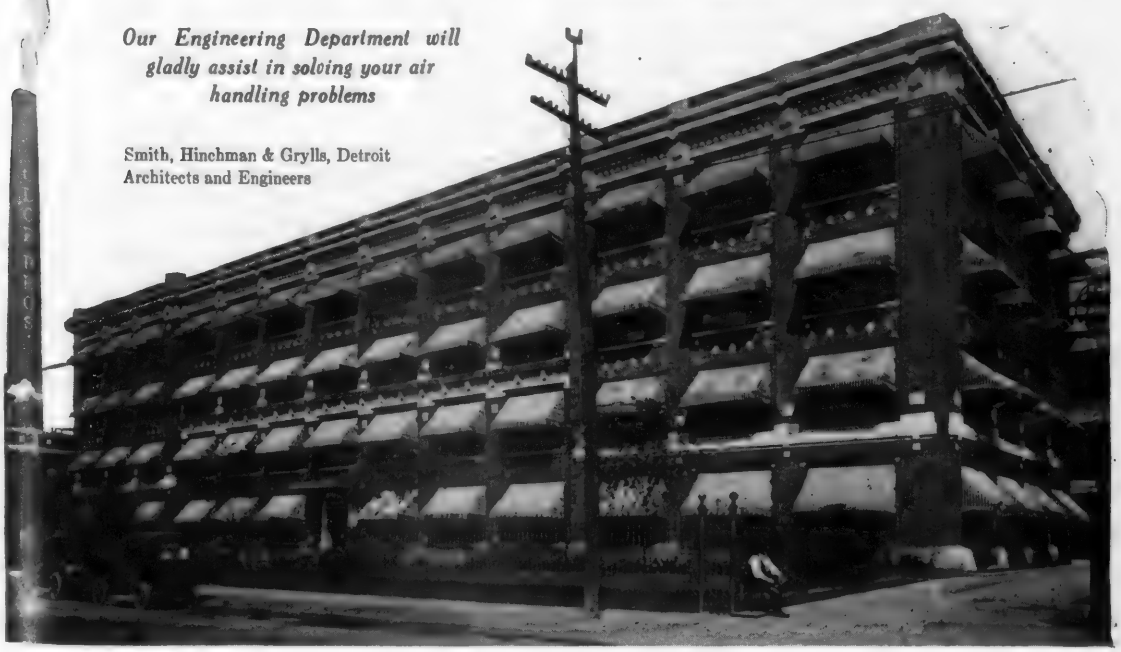

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opened quarters at 316-318 South Canal Street. President, Guy S. Faber, formerly with the American Radiator Company.

Contracts Awarded.

Read-MacDonald-Brewster, Inc., Minneapolis, Minn., was the successful bidder, at $68,692, for the central heating plant at Penn College, Oskaloosa, Ia., the work being divided as follows: For construction of heating plant, $19,444; for equipment of heating plant, $22,313; for main building heating and ventilating and control, $13,525; for vacuum cleaner for main building, $885; for heating of dormitory, $12,525. The contract for heating the men's gymnasium was to be let later.

Columbus Heating and Ventilating Co., Columbus, O., was the low bidder, at $10,900 each, for heating and ventilating the Whittier and Cleveland Schools in Dayton. These bids are for blast furnace systems. Other bids were: American Warming and Ventilating Co., Toledo, $12,000 each; and Stanton Heater Co., Martin's Ferry, O., $13,900 each. A bid was also received from William Haas, Dayton, of $29,400 for two steam heating plants in these buildings. The bid submitted by the Columbus concern is $590 lower than one previously submitted by the same company when the contract was awarded it. Later the award was abrogated when suit to enjoin the signing of the contract was entered in the Common Pleas court by M. J. Gibbons, of Dayton.

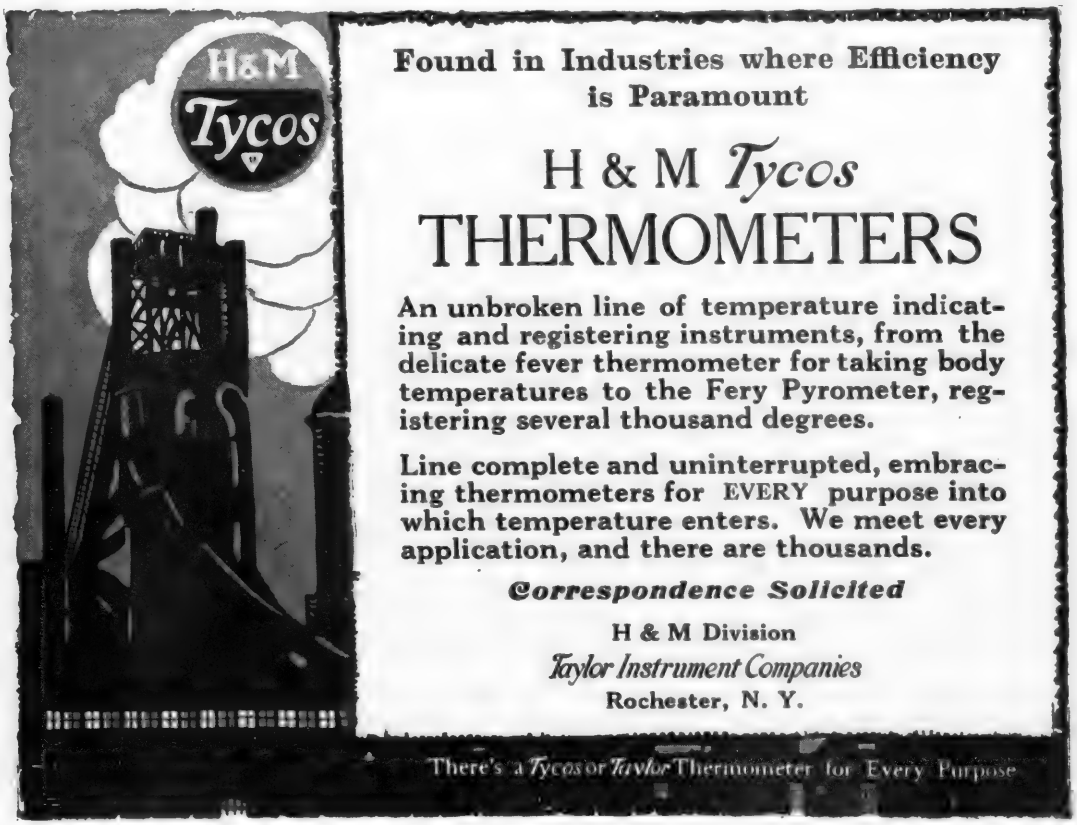
C. J. Ohlmacher & Co., Sycamore, Ill., heating plant of the Chicago Insulated Wire & Mfg. Co., of Sycamore. 10,000 sq. ft. of direct radiation will be installed.

Wells & Newton, New York, heating and plumbing new $400,000 storehouse on Blackwell's Island, New York, for the Department of Charities.

Gillis & Geoghegan, New York, heating and ventilating new hospital group of fourteen buildings for the Rockefeller Foundation, 64th Street and Avenue A, New York.

Teran, Mahaney & Munro, New York, heating installation in connection with new central heating, lighting and power plant at East View, N. Y.

John H. Cooney, Harrison, N. J., heating and ventilating Lincoln High School and board of education administration building, Jersey City, also heating and ventilating Hoboken High School.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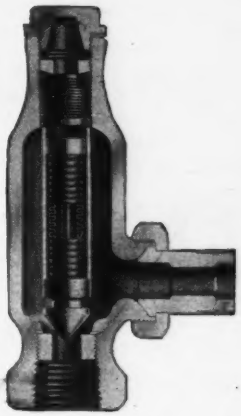

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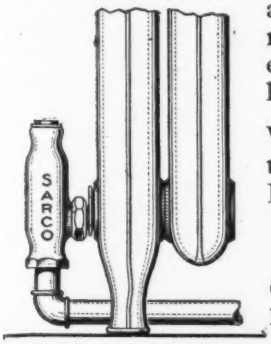

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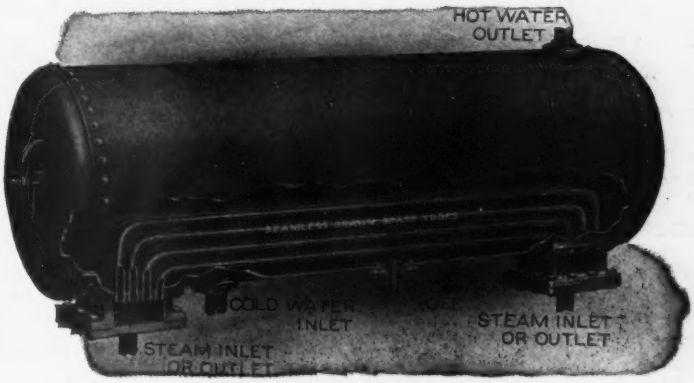

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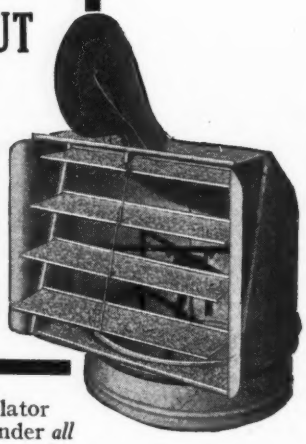

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VOL. XIV. NO 8.

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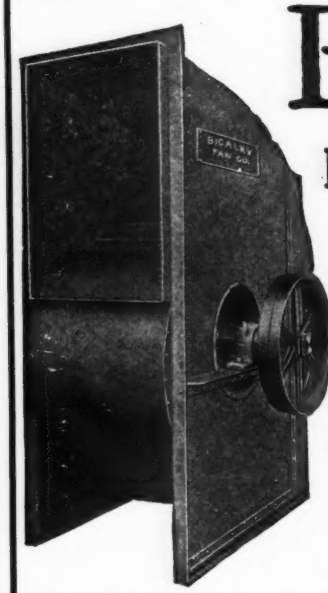

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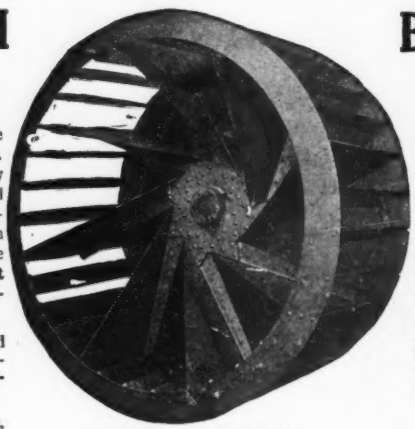

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